SES WATER

Our Water Resources Management Plan 2025 to 2075

October 2024

Document Revision History

Rev	Purpose	Originated	Reviewed	Authorised	Date
1	Initial draft for internal approval	A Murphy	T Kelly L Merritt	T Kelly	14 Sep 2022
2	Final draft for security review submission	A Murphy	N/A	T Kelly	30 Sep 2022
3	Final version for publication	A Murphy	T Kelly L Merritt	T Kelly	07 Nov 2022
4	Revised draft following consultation	G Wood-Lofthouse	T Kelly	T Kelly	31 Aug 2023
5	Updated environmental assessments published	G Wood-Lofthouse	T Kelly	T Kelly	22 Sep 2023
5.1	Final plan published following permission from Secretary of State	G Wood-Lofthouse	T Kelly	T Kelly	18 Oct 2024

Security and Confidentiality Statement

This statement is to certify that this plan does not contain any information that would compromise national security interests. It is compliant with the requirements of the General Data Protection Regulation.

It also does not contain any information that may be considered commercially confidential. No information been excluded from this plan on these grounds.

Contents

Appendices

We have several appendices to support our Water Resources Management Plan. Due to the complexity and detail associated with water resource planning, various appendices have supporting information. The following table denotes each of appendices across a level structure. This is intended to help readers navigate to specific materials.

In addition to the appendices listed below we have also published a set of Data Tables.

Level 1	Appendix Title	Level 2	Appendix Title
A	Groundwater Deployable Output Review		
B	Bough Beech Deployable Output Review		
C	Demand Forecast	A	Population Growth Forecast
		B	Non-household Demand Forecast 2020 to 2100
		C	WRMP19 Household Consumption Forecast: Baseline Forecast
		D	Demand Forecast Updates for the WRSE Regional Plan Report
		E	Demand Forecast – 2021/22 Rebase for WRSE
D	Headroom Assessment	A	@Risk Spreadsheet Outputs
		B	EDG and EDC figures
		C	Combined Adaptive Planning Profiles
E	Options Appraisal Methodology	A	Option Screening
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		D	Feasible Option Summary Details
F	Strategic Environmental Assessment	A	Strategic Environment Assessment Non-Technical Summary
		B	Component Appendices (numbered below)
			1 - Consultation Responses
			2 - Review of relevant Plans, Policies and Programmes
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			4 - Assessment Tables

Level 1	Appendix Title	Level 2	Appendix Title
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			6 - Water Framework Directive
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		C	Post Adoption Statement
G	Habitat Regulations Assessment		
H	Statement of Response	A	Consultation email sent to stakeholders
		B	Summary Consultation Document
		C	Online Survey Questions
		D	Our response to feedback from our Regulators
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		G	Our response to feedback from Environmental Groups
		H	SERT Consultation Response Template
		I	Defra’s request for further information following the Statement of Response
		J	SES Water’s response to Defra
		K	Defra’s letter providing permission to publish the WRMP

Glossary

Term	Definition
AA	Annual average
ADO	Average deployable output
AIC	Average incremental cost
AISC	Average incremental social cost
ALC	Active leakage control
AMP	Asset Management Plan
AMR	Automatic meter reading
AR	Artificial recharge
ARU	Aquifer resource unit
ASR	Aquifer storage and recovery
BNG	Biodiversity net gain
CAMS	Catchment abstraction management strategy
CBA	Cost benefit analysis
CO2e	Carbon dioxide equivalents
CP	Critical period
CSL	Customer side leakage
CSP	Customer Scrutiny Panel
Defra	Department for the Environment, Food and Rural Affairs
DI	Distribution input
DMA	District Meter Area
DO	Deployable output
DSOU	Distribution system operational use
DWI	Drinking Water Inspectorate
dWRMP	Draft Water Resources Management Plan
DY, DYAA	Dry Year, Dry Year Annual Average

Term	Definition
DYCP	Dry Year Critical Period
EA	Environment Agency
EBSD	Economics of balancing supply and demand
EFI	Environmental flow indicator
ESP	Environmental Scrutiny Panel
GES	Good Ecological Status
GhG	Greenhouse Gas (Emissions)
GIS	Geographic Information System
GLA	Greater London Authority
HDF	Hour Day Factor (to adjust NFM to account for daily pressure profile)
HRA	Habitat Regulations Assessment
KNC	Known Night-time Consumption (legitimate night use in a DMA)
INNS	Invasive non-native species
LNRS	Local Nature Recovery Scheme
LoS	Level(s) of service
MAbL	Minimum achievable leakage
MDO	Minimum deployable output
Ml/d	Million litres a day
NEUB	Non-essential use ban
NIC	National Infrastructure Commission
NPV	Net present value
NPWS	Non-public water supply
NRR	Natural rate of rise (of leakage)
NY, NYAA	Normal Year, Normal Year Annual Average
OA	Output area
OBH	Observation borehole
OBR	Office of Budget Responsibility
Ofwat	Water Services Regulation Authority
ONS	Office for National Statistics
PCC	Per capita consumption
PET	Potential Evapotranspiration

Term	Definition
PR19	Price Review 2019
PR24	Price Review 2024
PDO	Peak deployable output
RAPID	Regulators' Alliance for Progressing Infrastructure Development
RBMP	River Basin Management Plan
RRP	Regional Resilience Plan
SEA	Strategic Environmental Assessment
SELL	Sustainable Economic Level of Leakage
SESW	SES Water (trading name for Sutton and East Surrey Water plc)
SR	Sustainability Reduction
SSE	(Organisation formally known as) Scottish and Southern Energy
TPC	Traded price of carbon (for carbon emissions subject to the EU-Emissions Trading Scheme)
TUB	Temporary use ban
UKWIR	UK Water Industry Research
WAFU	Water available for use
WEFF	Water efficiency
WFD	Water Framework Directive
WINEP	Water Industry National Environment Programme
WRGIS	Water Resources Geographic Information System
WRMP(XX)	Water Resources Management Plan (14=2014, 19 = 2019, 24=2024 etc)
WRPG	Water Resources Planning Guideline, also referred to as the Guideline
WRSE	Water Resources South East
WRZ	Water Resource Zone
WTW	Water Treatment Works
%ile	Percentile

SECTION 1

Section 1 Introduction

1. Introduction

This chapter provides an introduction to our company and the regional planning we form part of in developing our plan. We provide an overview of our current plan and the integrity of our network to operate as one water resource zone. We set out the structure of this plan to help you navigate through the various chapters.

A. Outline

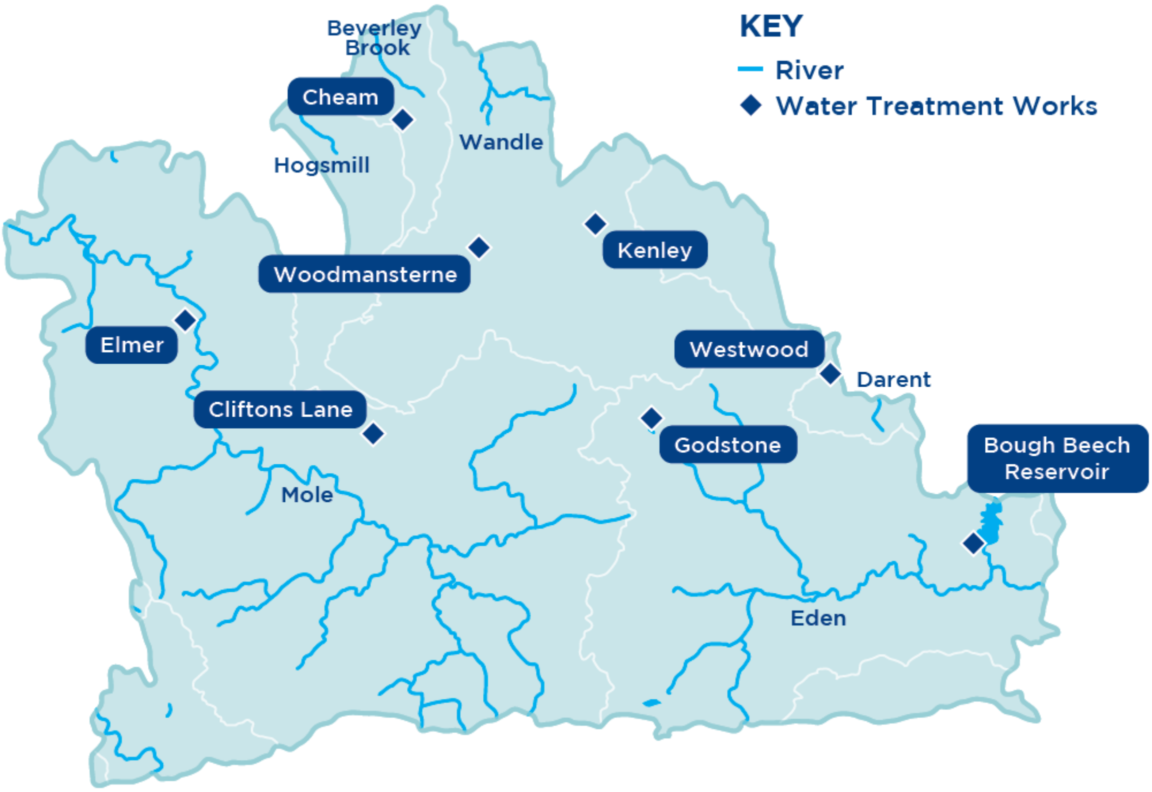
1. This is our Water Resources Management Plan 2024 (WRMP24). It is prepared as a technical document following the principles and requirements of the Water Resources Planning Guideline (WRPG, the Guideline), set by our regulators – the Environment Agency, Ofwat and Natural England. The WRMP24 is a statutory plan that must set out how we will provide a secure supply of water for our customers and protect and enhance the environment. These statutory plans are revised every five years.
2. To meet the Guideline we must provide a plan over the next 25 years that maintains a supply/demand balance. We have worked with neighbouring water companies – Affinity Water, Portsmouth Water, South East Water, Southern Water and Thames Water – forming part of **Water Resources South East (WRSE)**, to plan for a greater horizon of 50 years.

B. About SES Water

3. We are a water-only company operating across parts of Surrey, Kent, West Sussex and south London. We are classified as one water resource zone (WRZ) and serve a population of over 750,000.
4. The greater proportion of our water (roughly 85%) is abstracted from groundwater sources in the chalk and greensand strata across the North Downs. Our catchments include rare chalk stream habitats which are of national ecological importance, and we are building this plan to encompass our ambition to reduce abstraction.
5. Our remaining water supply is abstracted over the winter from the River Eden and stored at our Bough Beech Reservoir. All our sources rely on winter rainfall – to recharge our groundwater sources and ensure there is sufficient river flow along the River Eden to enable abstraction.
6. On average we provide 160 million litres of water a day. During the summer 2022 drought demand rose to 210 million litres a day[1].
7. Over the last 15 years we have worked to deliver a resilience programme across our network so that each of our customers is supplied from two or more treatments works. As such, we can move water from our Bough Beech WTW to the central and northern parts of our supply area. We are on track to complete this programme by 2025.

1 Peak week 13-19 Jul 2022.

Figure 1: Our area of supply and operational catchments.



C. Our customers

8. Our 750,000 customers are supplied via nearly 300,000 properties. Around 14,000 properties are classed as non-household and are billed by a water retailer. The remaining 286,000 properties are classed as household or non-household (but are not eligible for the retailer market).

   The population is largely permanent with relatively low numbers of second homes and visitors in comparison to other areas in the South East. Our non-household sector largely includes population services, such as hospitals and schools. There is a low proportion of manufacturing and industrial customers, but we supply Gatwick Airport – our largest customer in terms of demand – for whom we receive specific forecasts.

D. Our current Water Resources Management Plan

9. We are currently operating under our Water Resource Management Plan published in 2019, known as WRMP19, which took effect from April 2020. In this plan we committed to demand reduction activities – focused on leakage, water efficiency and our universal metering programme. Covid-19 has had an impact on both our delivery of these commitments and the way our customers now use water.
10. Covid-19, and previously Brexit, have also affected population growth in our area – primarily focused on where individuals choose to live. Separately, Covid-19 has also specifically caused a shift in working practices which has resulted in higher water consumption across the properties we serve.
11. As our plan will explain, we have comparatively resilient water resources and therefore have a surplus of water for our own needs. We started supplying Southern Water in

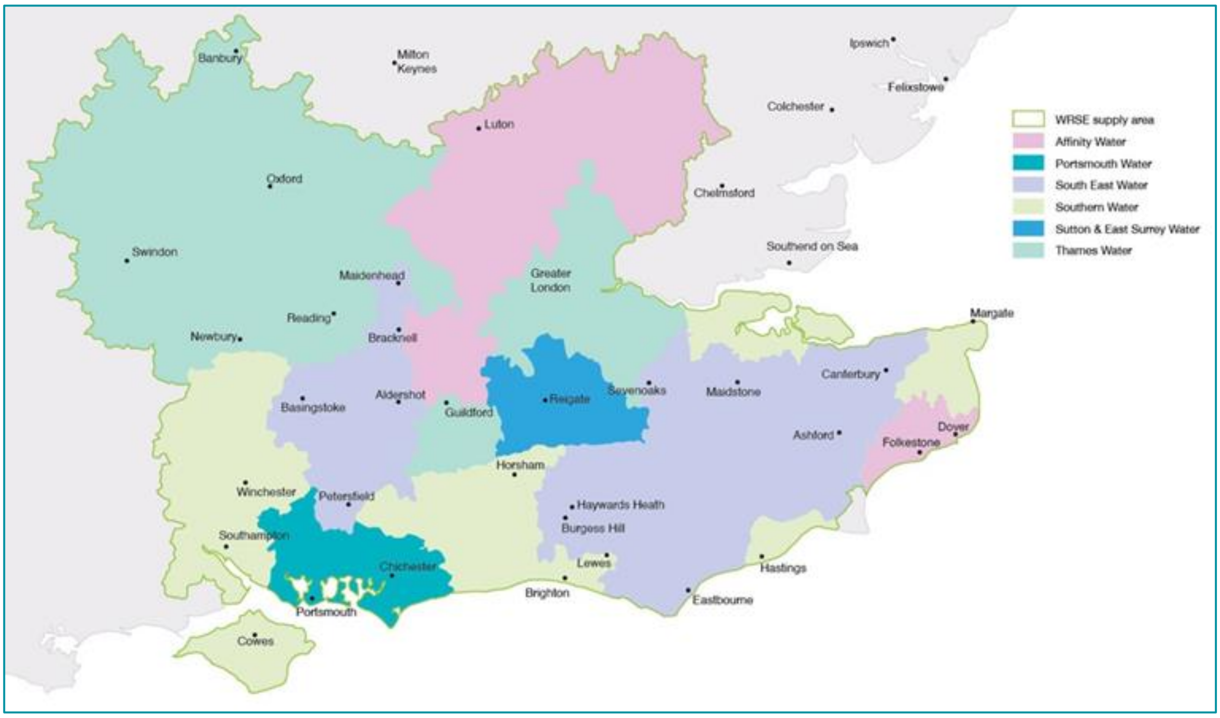
2021/22 with a new bulk supply at Crawley, supplied from our Outwood Service Reservoir (filled from our Bough Beech Water Treatment Works). The volume of water supplied started at 0.3 Ml/d, with a plan to increase this to at least 0.9 Ml/d by the end of 2022/23. Whilst this was not included in the current plan but results in an increase to our demand forecast, it is not considered to be a material change in circumstances.

E. Regional planning

12. The water resource challenges faced in the South East are substantial – and shared across all water companies in the region. The establishment of a National Framework has set out expectations for water companies to work in regional groups and develop a cohesive set of plans that deliver the best value for the environment and society. The regional plans must also take account of all sectors, including those that receive water from non-public water supplies.

13. We therefore form part of an alliance, together with all water companies operating in the area and the Environment Agency, known as WRSE. We work together across all elements of water resource planning to develop a regional plan that provides an affordable, resilient and sustainable water supply to deliver for the public, industry and the natural environment.

Figure 2 Regional companies forming part of WRSE



14. Each company's plan must reflect the regional plan unless there is clear justification for not doing so. Our continued approach is that our plan, as set out in this document, will remain fully aligned with WRSE's regional plan.

F. Our Water Resource Zone (WRZ) integrity

15. We are required to demonstrate that our Water Resource Zone (WRZ) meets the specified definition to ensure our water resources planning units are fit for purpose. The UKWIR/EA definition of a WRZ (2012) is *the largest possible zone in which all resources, including external transfers, can be shared and hence the zone in which all customers will experience the same risk of supply failure from a resource shortfall*.

16. A WRZ is an area in which the management of supply and demand is largely self-contained, with the exception of bulk transfers into or out of the zone. It is acknowledged in the Guideline that *perfect integration is not possible, as there will always be limitations to a supply network. However, the main factor is that significant numbers of customers should not be experiencing different risks of supply failure*.

17. From the time of the Company merger in 1996 up to the plan in 2014, we based our resource planning on two WRZs; namely Sutton WRZ and East Surrey WRZ. Over that period, several trunk mains have been commissioned to interconnect the two zones, mainly to be able to transfer water supplies from East Surrey into Sutton during peak periods to improve the ability of the supply network to respond to emergency outages.

18. This connectivity also assists with achieving our performance commitment of being able to supply all customers from more than one treatment works by 2025. By 2025, the capacity of these trunk mains will be to transfer around 47% of demand from the East Surrey area to the Sutton area, and 41% from Sutton area into East Surrey area. On this basis, we determined for WRMP19 that the WRZ integrity criteria allows the whole supply area to be classified as one WRZ. The Environment Agency indicated that they were supportive of the results of our assessment, and therefore we have continued to plan for future needs on this basis.

19. With respect to water quality, our supplies are treated to a similar level of quality and hardness, and therefore there are no restrictions on which source customers can receive their water supplies from. We utilise the same disinfection method at all our treatment works and therefore mixing of supplies would not cause any additional taste issues, although there will be some difference in the amount of chlorine dosed between works.

Maintaining WRZ integrity in the future

20. Where options are being considered to meet a supply-demand deficit, consideration is given to the cost of maintaining WRZ integrity from the point of view of any necessary trunk mains upgrades within the option costs. These upgrades may have simultaneous supply-demand and resilience benefits. This ensures that the strategic transfer of any additional resources across the supply area is maintained.

21. It is likely that some local distribution network upgrades may be required to convey water from trunk mains to the areas where the forecast increases in demand actually occur. These requirements will not be known in detail until development applications are received. Therefore, in respect of local distribution mains, we would not expect to require any additional upgrades during the planning period over and above those allowed for in our business planning under:

    - Mains extensions for new developments and
    - Incidental upsizing

22. We do not consider it feasible to include local distribution mains upgrades within specific supply-side scheme costs used to inform the preferred plan as there would be a risk of double counting of upgrades should they be required in more than one selected scheme.

G. Navigating this plan

23. We have developed the layout of our plan with the intention that it can be followed by our customers and stakeholders, as well as our regulators. We must provide particular details within this plan, to comply with the Guideline, and we have therefore provided the table below to help readers navigate through the document.

Table 1: Navigating this plan

Section	Title	Inclusion
1	Introduction	We provide an overview of our company and the regional water resource planning group we form part of. We set out our water resource zone integrity, to comply with the Guideline. We outline the different chapters of this plan to assist with its navigation.
2	Shaping our plan	We set out the various elements of legislation and regulation that we must adhere to and/or align with. We also provide an overview of water industry specific plans we prepare. We detail the engagement we have undertaken with the public, our customers and stakeholders to develop our water resource planning, and the approach to this plan. We provide an explanation of how we assess the value attributed to components of the plan, which informs our selection of the appropriate options to manage our balance of supply and demand. We denote the basis of planning, including the time frame, possible scenarios, and level of resilience we are planning for.
3	Water supply	We cover an assessment of our deployable output (DO) and the water available for use (WAFU) We detail the impact of climate change and set out our plans to meet environmental destination, including the Water Industry National Environment Programme (WINEP) and our operational work. We include an assessment of water used to support our operations and which does not form part of our supply to customers. We comment on the drought of 2022.
4	Demand for water	We set out our demand forecasts across household and non-household customers, and cover the demand anticipated for bulk supplies and new appointed variations (NAVs). We detail our performance on leakage, and the demand related to distribution system operational use (DSOU) and water taken unbilled. We consider the impact of Levels of Service (LoS), relating to Drought Orders.
5	Baseline supply/demand balance (SDB)	We detail the methodology to define our baseline supply demand balance and uncertainty (our headroom allowance). We provide our baseline supply demand balance and compare this to our current plan – WRMP19. We comment on the baseline drought vulnerability framework.

Section	Title	Inclusion
6	Our options	We set out our approach to identify options to provide a secure and resilient water supply. We set out an overview of the different options, commenting on some additional opportunities that has not been captured in this plan, but that we are keen to develop for further iterations.
7	Decision making process	We provide a summary of our current plan and the problem characterisation following the assessment of supply and demand. We highlight our approach to the concept of adaptive planning, components of the plan scenarios, when we need to make decisions and how to monitor the plan. We set out our plan programmes – our least cost plan, our best value plan and the best environmental and social plan.
8	Our preferred plan	We detail our preferred plan and provide analysis from sensitivity to ensure its robustness. We provide an insight to the affordability of the plan. We provide an overview of the Strategic Environmental Assessment.
9	Quality assurance	We detail our governance structure and confirm our plan has been approved by our Board.

This chapter has set out that we support over 750,000 customers, providing 160 million litres of water a day, mainly from boreholes in the chalk and greensand strata across the North Downs. Our catchments include rare chalk stream habitats which are of national ecological importance, and we have developed this plan to align with our ambition to reduce abstractions.

We have commented on our current plan, concluding that it is still fit for purpose although we have been impacted by Covid-19 with changed behaviours towards water consumption (initially due to stay at home orders and more recently through changed working practices). The pandemic also caused delays in implementing our demand reduction programmes.

We have confirmed that we operate as one water resource zone to comply with the Water Resources Planning Guideline.

SECTION 2

Section 2 Shaping our plan

2. Shaping our plan

This chapter provides details across the various components that help us shape our plan – from legislation, engagement with customers and stakeholders, to water industry regulated planning. We set out how we have used these components to develop a best value planning approach, and we latterly outline the horizon and scenarios we need to plan for. This includes the level of resilience we are aiming to achieve and our current assessment of drought vulnerability.

A. Legislation and regulation

1. There are several key pieces of legislation, some more recently introduced, that set out the requirements of our plan to be compliant and the further expectations we should align with where possible. We have set out the legal and regulatory frameworks below.

The Water Industry Act 1991 and Water Resources Planning Guideline (WRPG)

2. As a statutory water undertaker, we are obligated by statute to prepare and maintain a water resource management plan that sets out how we will manage and develop our water resources to ensure we meet our legal obligation to provide water. The Water Industry Act 1991 (the Act) denotes that we must estimate our demand, the measures required to ensure security of supply and the timing and sequence of those measures. We receive permission from the Secretary of State to publish our plans, following consultation, and we can otherwise be directed by the Secretary of State as necessary in matters concerning our Water Resource Management Planning.
3. To support the process of water resources planning, the Environment Agency, Ofwat and Natural England prepare a guideline – the Water Resources Planning Guidelines (WRPG) – focusing on the legal requirements and technical approaches we should follow.
4. Other relevant organisations include the Drinking Water Inspectorate (DWI), which has responsibility relating to the sufficiency and quality of supplies. In addition, Ofwat, the EA and DWI have set up the Regulators' Alliance for Progressing Infrastructure Development (RAPID) to accelerate the development of new strategic infrastructure. Where RAPID is relevant to our plan this will be discussed during the latter parts of this document.

25 Year Environment Plan, Environmental Improvement Plan (EIP) and Defra's Integrated Plan for Water

5. This plan takes the Government's ambitions into account, particularly in relation to environmental sustainability, supporting the recovery of nature, using a natural capital and catchment approach and delivering a net gain to the environment. We have worked as a region to produce a methodology which addresses these aims as part of the transition to best value planning. We have covered this in further detail in Section D of this Chapter.
6. The introduction of the Environmental Improvement Plan (EIP) has set out valuable expectations across sectors to substantially work towards environmental improvements. For water companies this has included specific targets to reduce leakage (by 50% by 2050), non-household demand (by 9% by 2037) and stepped targets to reduce household demand on a per capita basis (7% by 2027, 12% by 2032, and 20% by 2038).

7. Defra's Integrated Plan for Water goes further to drive a multi-sector and localised (catchment-based), approach to the water system. This is to achieve improved connectivity between water infrastructure (natural and/or built); resource use; environment needs and climate adaptation; social value, biosecurity and pollution risk; and biodiversity.

8. We consider these updates to legislation, and particularly the Integrated Plan for Water, wholly aligns with our Purpose, and action, of **harnessing the potential of water to enhance nature and improve lives**.

Strategic Environmental Assessment (SEA)

9. This assessment is required under the Strategic Environmental Assessment (SEA) Directive because we are preparing a *statutory* plan that sets a framework for future development requirements (and therefore consent) with the potential to have significant impacts on the environment. This work was carried out following the options selection stage. Outputs from the SEA have been integrated into the evaluation of the plan – covered in Chapter 8 – and the SEA Environmental Report is published alongside the plan as a separate Appendix.

10. This report also includes a Habitats Regulations Assessment (HRA) of the impact of the options selected.

APPENDIX F
SEA Environmental Report

River Basin Management Plans

11. Water companies have a duty to ensure that their WRMP delivers the actions needed to meet the Abstraction Plan for 2027 and those required to meet the objectives of the Water Framework Directive (WFD), as defined in the River Basin Management Plans (RBMPs). The overall aim of the RBMPs, which are updated every six years, is for water companies, stakeholders and communities to work together so that more water bodies achieve a 'good status' or a 'good potential'. Our supply area is largely within the Thames RBMP, which was last updated in 2018.

12. Specifically, we must ensure that planned abstractions will:

- Prevent deterioration in water body status (or potential) compared to the baseline reported in the 2015 RBMP
- Restore sustainable abstraction if there has been deterioration in the first RBMP cycle (2015 to 2021)
- Support the achievement of protected area and environmental objectives
- Contribute to sustainable catchments by ensuring supplies are well managed in a drought
- Demonstrate how customers are helped to use water wisely
- Identify integrated catchment-based solutions that deliver multiple benefits

Further details setting out how this plan supports the objectives of the WFD and RBMP is given in Chapter 8.

Local Authority Plans

13. All local authorities consult on and publish Local Plans detailing how they will accommodate and plan for growth in their areas, including homes, schools, and businesses. They are required to report at least annually on their progress with preparing their local plans, which are examined by the Planning Inspectorate.

14. The information contained in the latest available projections indicate likely numbers of new properties to be built over the next 15 years, as well as the number of houses considered to be 'needed' which is usually higher. We are required to reflect the planned growth ambitions in our demand forecast so that we meet the additional needs of new households

and businesses. We also assess the demand which would occur if the level of 'housing need' is met. The outcome of this assessment is provided in Chapter 4.

Flood Risk Management Plans

15. We periodically complete flood risk assessments of our critical infrastructure. Over the 2015-2020 period we carried out several improvements to flood protection at key sites, primarily at our Kenley Water Treatment Works (WTW) where a significant flooding event occurred in March 2014. We are currently developing proposals to mitigate the risk of flooding at our Leatherhead Pumping Station, together with other assets that may require improved resilience to flooding events. These proposals will form part of regulated business plans.
16. We will continue to work with local authorities, the Environment Agency and local residents so that flood action plans can be implemented and discussed with the communities involved.

Local Nature Recovery Strategies (LNRS)

17. These were introduced in the Environment Act 2021 and require public authorities to have a duty to support recovery and enhancement of biodiversity and the resilience of ecosystems. The Act in general will set binding targets for core areas, including water, with the hope that these changes will assist in the transition to a more circular economy.
18. The LNRS includes provision for a legal requirement to provide a Biodiversity Net Gain (BNG) for certain types of development. Whilst these were provisions were not in force during preparation of this plan, the Guideline encourages us to go beyond what might be required by the Environment Act. As a regional group, we opted for an ambitious level of BNG in the plan.

B. Water industry regulated plans

19. As a regulated water company we also produce a suite of plans to define our committed activities and associated price controls.

Our Long-Term Delivery Strategy (LTDS)

20. Our Long-Term Delivery Strategy, due to be published for consultation in autumn 2023, will define our planned outcomes over a 25 year planning horizon. It will also set the context for our forthcoming five-year business plans. These outcomes will consider our customers' priorities so that we can meet their expectations and highlight where we could go further to deliver greater value to the people we serve and the environment we rely on.

Our Business Plan

21. We prepare five-year business plans defining our company-wide activities (including water resources) to ensure we operate as our customers expect. Our regulator, Ofwat, scrutinises these plans to set the price controls for that five-year period (known as an Asset Management Plan, or AMP). We are currently in AMP7, and AMP8 will cover the 2025 to 2030 period.
22. The process to develop the AMP8 business plan, known as the Price Review, has started and we are engaging with our customers to identify both their long- and short-term priorities. We will submit our business plan to Ofwat in October 2023, together with our LTDS. Both submissions will be aligned to this plan.
23. Our current business plan[2] focuses on five customer pledges:

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2 Available to download at 5-years-5-pledges-online-version.pdf (seswater.co.uk)

- High quality water all day, every day
- Fair prices and help when you need it
- A service that is fit now and for the future
- Excellent service, whenever and however you need it
- Support a thriving environment we can all rely upon

24. We developed our plan to achieve these pledges through the three key themes of **customer service**, **affordable bills** and **long-term resilience**. These themes are relevant to water resources planning and align with our stakeholder engagement to develop the best value planning approach.

25. As we progress with developing our business plan for 2025-2030, alongside this plan, we will ensure the two reflect each other so that the final version of the WRMP aligns with the direction we intend to take across every area – from water treatment to customer service.

26. In the meantime, for the WRMP, we have used the Ofwat document *PR24 and Beyond: Long-term delivery strategies* to provide direction for adaptive planning, common reference scenarios and using robust and consistent costings.

Our Drought Plan

27. Water companies in England and Wales are required to prepare and maintain drought plans. These plans set out the operational actions companies will consider taking in response to drought events of different severities, guided by the position at any time of reservoir and groundwater levels in relation to specified triggers. The aim of the plan is to minimise environmental impacts, but where potential impacts are identified, it presents a balance of measures that may include restrictions on customers' use of water.

28. Although a drought plan is an operational plan – whilst the WRMP is designed to be strategic – there are some significant links. Both plans utilise the same methodology for assessing the amount of water available for use and the level of resilience to severe droughts – using a modelling approach to assess the risk of a certain level of drought occurring. This is described further in Chapter 3. In addition, drought management actions are designed to be consistent with the target levels of service set out in the WRMP, as described in more detail in Chapter 6.

29. We recently updated our Drought Plan (published in November 2022). The options available to us in a drought are largely the same as those previously identified but we have updated the thresholds or 'trigger points' when these options are required based on the latest hydrological and stochastic drought frequency data. This data, including an assessment of water available for use, is aligned with that used in this plan.

30. For the first time we have carried out a Strategic Environmental Assessment (SEA) of our Drought Plan. A proportion of the baseline information and output results has been used to conduct a SEA of this plan, since the same local factors apply in both cases and also some of the same options are utilised in a drought situation.

31. As set out in our Drought Plan, we may implement various Drought Orders and Permits as a drought progresses in severity (through defined Zone Levels 0 to 4). These include both demand-side (water use restrictions) and supply-side (drought sources and transfers) measures. As required by the Guideline, we have now included the demand reductions and additional supplies in the long-term water resources planning calculations. This reflects the position that during a severe drought these measures are very likely to be in place, although there will be uncertainties associated with the level of benefit achieved. This is discussed further in Chapter 6.

Drinking Water Safety Plans

32. These plans are the mechanism for assessing risks in the catchment that we abstract from source to tap and are reviewed continuously. Our WRMP takes account of the hazards identified in our plans and has assessed how these risks could be mitigated by the options selected. Where an option could improve the supply-demand balance, for example through catchment management, it is considered in this plan.

Drainage and Wastewater Management Plans (DWMP)

33. These plans were initiated in 2022 and the wastewater providers in our area (Southern Water and Thames Water) have since published their final plans. We are not required to produce our own DWMP as we are a water-only company and do not undertake any drainage or wastewater operations for our customers.

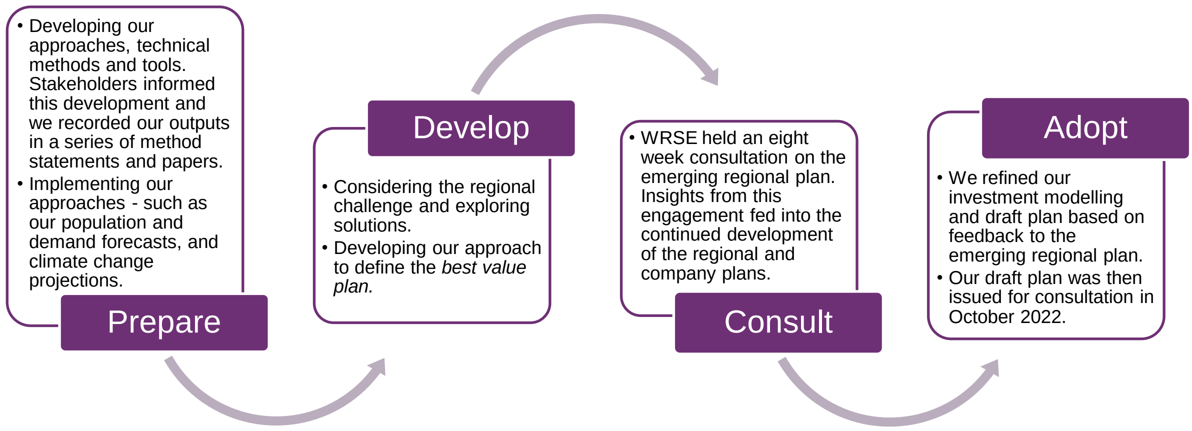
34. We will work with Southern Water and Thames Water to ensure that we are aligned in any area not covered by the regional planning approach. This will not prohibit us from working collaboratively on projects in the meantime, and we believe the wastewater and drainage providers operating in our area will be important contributors to catchment work we are initiating.

C. Public, customers and stakeholders

35. Due to the implications of regional planning, each company in the southeast worked together (as part of WRSE) to engage with customers and stakeholders. This included establishing stakeholder groups comprising the Stakeholder Advisory Board, the Environmental Advisory Group, and the Multi-sector Advisory Group to ensure focused engagement and advice on key aspects of the plan. Statutory and non-statutory members formed part of the advisory groups, and engagement was undertaken with the wider stakeholder community through meetings and the use of online channels[3].

36. This plan, which reflects the evolution of the best value planning approach and regional plan, has been developed using the following phases of engagement and consultation.

Figure 3 Overview of phases of engagement and consultation

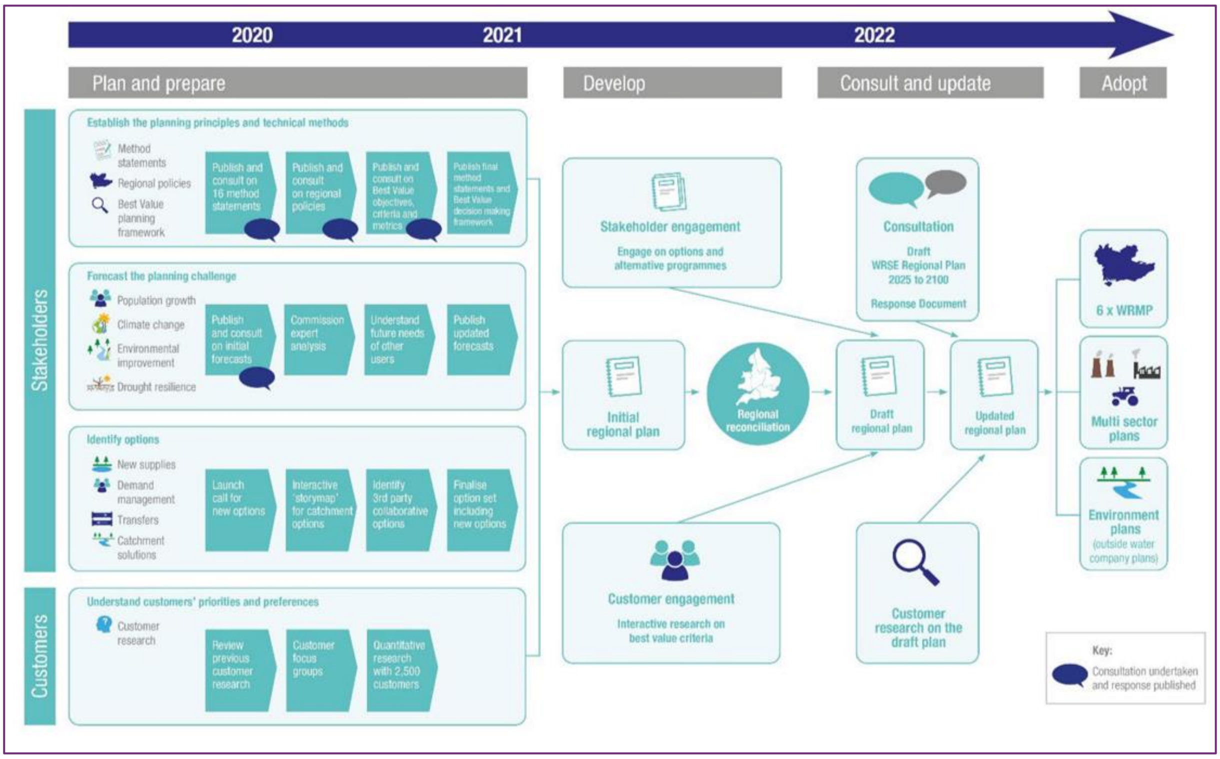


37. Figure 4 (overleaf) below provides a more detailed illustration of the stages where consultation was undertaken, or engagement was sought, to develop the planning

3 Stakeholder engagement report (WRSE, January 2022)

principles and technical methods; the options and alternative programmes; best value criteria and the emerging regional plan.

Figure 4 Engagement framework (WRSE)



Understanding customer preferences and priorities

38. As a regional group we used Eftec and ICS Consulting to understand customers' views and preferences for long-term water resources planning[4]. Their findings, collated from an evidence review, deliberative research and customer surveys, set out broad support for regional planning that should deliver beyond the minimum requirements to ensure long term security of supply. In addition, this approach should reduce the dependency on the environmental system and build in additional capacity to reduce risk associated with wider uncertainty and disruption.

39. The findings presented support for the environment – outlining that resource planning presents an opportunity to enhance the water environment through reduced dependency on the water system, as well as safeguarding water supplies over the long-term.

40. Customers also expressed their views that service levels should be maintained as a minimum, and that companies should avoid a reliance on 'risky' solutions – with customers preferring an acceptable balance of options (across supply and demand, timing and implementation).

41. Affordability of the plan was also a key theme from the findings, particularly echoing the bills needed to remain affordable to vulnerable and low-income households.

Engagement to inform the best value planning criteria

42. We developed best value metrics (covered in the next section) and defined customer preferences and weightings (both qualitative and quantitative) to feed into the regional investment model[5]. The components broadly included:

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4 Customer preferences to inform long-term water resource planning (WRSE, March 2021)
5 Engagement with customers method statement (WRSE, November 2022)

(a) Establishing metrics to compare alternative plans, objective setting and best value criteria to ensure effective customer interpretation of definitions.

(b) An early view of the acceptability, across bill impacts and key drivers for customer support, to provide early guidance and aid the identification of the best value plan.

(c) Understanding preferences for solutions, to recognise acceptability of risk and trade-offs for costs, which outlines the 'value' for the investment model customer preference metric.

(d) Customer weighted for best value criteria to provide a 'multiplier' that informs the investment model.

Emerging plan engagement

43. The emerging regional plan, which encompassed our ongoing work to develop our supply forecast, regional demand forecasts and options reassessment, was consulted from January to March 2022[6]. As such, the responses gave a specific insight to the representations we could expect (both as a company and regionally) for our draft plans.

44. Many respondents welcomed the work that had gone into the emerging regional plan, recognising the difficulties of preparing a long-term strategy for the region. The increased emphasis on environmental protection through abstraction reduction was specifically supported, and respondents generally supported the twin track of demand management and resource development, albeit with comments on some specific proposals.

45. The emerging regional plan was based on a cost-efficient plan – not a best value plan – and the cost-focused nature of the option selection and decision-making was a concern expressed by some respondents. Our draft plans (regionally and individually) are based on the best value metrics – responding to the need to incorporate wider environmental and social factors into the strategy.

Our pre-consultation of the draft plan

46. The Guideline requires that we carry out consultation, in advance of the public consultation, with our Board, regulators, customers and other stakeholders – especially if our plan is likely to be complex or include significant change. We consider that this plan is not significantly different to the plan published in 2019, however, with the shift to regional planning we have undertaken structured discussions with regulators across three levels of regional coordination: Programme Management Board, Oversight Management Group and Senior Leadership Team. These include members from Ofwat and the Environment Agency, with involvement from Natural England where required.

47. This close collaboration has resulted in the regulators being fully involved in the evolution of the regional plan and the decisions needed to meet the change in planning required to determine strategic schemes to safeguard our water resources. Wider engagement has also been coordinated with other groups, including RAPID, the DWI, National Infrastructure Commission, as well as the other regional water resource planning groups of England & Wales.

48. We independently held sessions with the Environment Agency and Ofwat, in January and July 2022, to shape our resource planning. In addition, we have held discussions with the local area Environment Agency team, in particular to discuss our environmental destination scenarios. We will carry out further discussions with statutory consultees as part of the SEA and HRA process since our plan may impact on designated sites.

49. Within the company, we have briefed, and been challenged by, our Board and Environmental Scrutiny Panel (ESP). The ESP is formed of representatives from

6 Emerging regional plan consultation response document (WRSE, May 2022)

regulators, local organisations and independent members whose core objectives are to ensure we:

- develop a robust long-term environmental strategy,
- align with best practice and contribute to regional environmental initiatives,
- are scrutinised on our enviornmental performance commitments and obligations, and
- critiqued on the development of our long-term plans including our water resources strategy.

Our formal consultation of the draft plan

50. Our Statement of Response (Appendix H) provides detail across the representations made to us on our draft plan. To assist with the review of our revised plan (which forms our published plan), we have set out some key themes arising from our consultation below.

APPENDIX H
Statement of Response

Theme	Detail
Narrative	We received challenge on the level of narrative provided in our draft plan and, to some extent, the readability. We have restructured our plan and provided updated or additional narrative across the following key areas (as identified in the representations) • How customer and stakeholder engagement has informed the evolution of water resource planning and determining 'best value' • The development of the best value planning approach and adaptive planning • Our environmental ambition and the wider role we have in enhancing the environment we operate in • Our decision making to define options across various plan programmes and the appraisal undertaken to determine the preferred plan
Securing supplies	We received representations on our assessment of deployable output and how we calculated the benefit of options. We were also asked about climate change. We have provided detailed responses in our Statement of Response but have updated Chapter 3 throughout to better set out our assessment of deployable output and the impacts of climate change. We have also provided an overview of our supply options in Chapter 6 and prepared and an additional appendix (see Level 1 Appendix E, Level 2 Appendix D *Feasible Option Summary Details*) to provide additional information.
Managing demand	We received challenge on our proposed rollout of smart metering, with various respondents proposing a faster rollout that is uniform across household and non-household customers. We have considered this and updated our plans (covered in Chapter 6). We were informed that our leakage costs were comparatively higher than other companies which we believe is as a result of operating beyond the economic level of leakage. We have reviewed our leakage strategy and cover an alternative approach in Chapter 6 that aims to reduce the cost of leakage in AMP8. We have also included details around our leakage unit costs under the direction of Defra and Ofwat following our Statement of Response. We received comments sharing concern over the risk of effectiveness of our demand management strategies, although respondents recognised our ambition. The Environmental Improvement Plan has since required us to go further with demand management and we have therefore undertaken a series of sensitivity analysis when developing this plan. The revised demand strategies are covering in Chapter 6 and our sensitivity analysis is provided in Chapter 8.

Theme	Detail
Improving the environment	We received comments on our SEA and HRA assessments, concerning components and methods of our assessments. We have provided assurance within our Statement of Response of those components and altered/updated sections where required to support additional clarity. The latest updates to these assessments are ongoing and we expect to reflect them within this plan and publish the Appendices in September 2023.
Building our plan	We received challenge on the pace of the plan to achieve our environmental destination and whether proposed transfers reduce our ability to do more for the environment. We have explained in Chapter 3B that our environmental destination has been considered as part of our baseline. We have also better explained the series of investigations we will undertake to confirm the appropriate profiles of abstraction reductions so that we can refine our supply baseline in future iterations of this plan. We have been asked to provide discussion on the drought vulnerability framework or equivalent approach, to assess our system resilience. We have provided further information on our assessments in Chapter 5D and 8B. we believe we will need to carry out some further work to understand whether possible network constraint may exist, and we propose to undertake that work following our environmental destination investigations so that we can define where enhancements may be required to realise our environmental ambition and have continued system resilience. We were also challenged on our headroom assessment. We have reviewed our headroom model and updated our target headroom calculation, reviewing any implications on our plan and feeding the updated assessment into the regional modelling. Chapter 5B and Appendix D provide further information.

51. We believe our consultation responses, in addition to the engagement throughout the planning process, has allowed us to make improvements to this plan and consider its robustness across the planning horizon.

D. Developing the best value planning approach

52. In the context of water resources planning, a **best value plan** is one that considers a range of factors (not exclusively financial cost). As a minimum any plan must meet the legislative and regulatory requirements and other policy expectations in an efficient, affordable and deliverable way. A best value plan seeks a solution that not only secures supplies for customers, but also increases the overall benefit to customers, the wider environment and society as a whole – as defined through best value metrics. Working together as a region, we have chosen to use advanced decision-making methods to develop a regional and company plan that can adapt to different future scenarios.

53. We are expected to consider a suite of factors to comply with the Planning Guideline and expectations of the National Framework, along with Ofwat's public value principles. Factors include:

- cost, affordability of our customers' bills and intergenerational equity,
- resilience to drought and non-drought events,
- measurable and lasting social and environmental benefits that are important to customers and communities,
- environmental protection and improvenent, with specific reference to biodiversity, natural capital and net zero carbon, and
- customers' preferences.

54. Engagement with customers (as described in the section above) informed our understanding of their priorities so that we could represent these in our best value objectives. These objectives are defined as follows[7]:

Figure 5 Defined best value objectives

Deliver a secure and wholesome supply of water to customers and other sectors.	Deliver environmental improvement and social benefit.	Increase the resilience of the region's water systems.	Be deliverable at a cost that is acceptable to customers.

55. To further define the best value metrics, we developed measurable indices to be able to assess best value. Each objective is therefore represented by a set of *value criteria* and an associated metric to define the additional value associated with that criterion.

56. The value criteria are used as a constraint or optimiser factor within the modelling. Constraints are used to ensure the investment modelling provides solutions that reflect our statutory requirements, and the optimiser factors enable effective programme appraisal across the various possible programmes. This level of detail provides an opportunity for us to liaise with stakeholders on the respective costs, benefits and outcomes, and develop a best value plan.

57. An overview of the value criteria is provided below:

Table 2 Value criteria to deliver a secure and wholesome supply of water

Value criteria	Detail	Metric	Criteria type	Data source	Further information/ reference material
Meet the supply demand balance	We must meet a supply demand balance so that there are no deficits across the planning horizon.	Public water supply (Ml/d)	Constraint	Final supply demand balance for public water supply	(Regional) planning tables
	Regionally, we have sought to meet the needs of other sectors and engaged with those that rely heavily on water across the South East.	Provision of water needed by other sectors (Ml/d)	Constraint	Non-public water supply demand forecast	Regional multi-sector method statement
Leakage	Water companies have committed to leakage targets, initially based on the Public Interest Commitment	% reduction in leakage from baseline	Constraint	Annual Review data	Regional options appraisal method statement
	Options can be pursued to further enhance leakage reduction.	% leakage reduction from constrained level (above)	Optimised	Option level assessment	Regional options appraisal method statement
Water into supply	Water companies propose programmes	Distribution input (Ml/d)	Optimised	Option level assessment	Regional options appraisal

7 Best Value Planning Method Statement (WRSE, November 2022)

Value criteria	Detail	Metric	Criteria type	Data source	Further information/ reference material
	to reduce water usage.				method statement
Customer preference	Research was conducted to understand customer priorities and preferences. Scoring is attributed to assess and compare performance.	Customer preference for option type (score)	Optimised	Customer research	Regional customer engagement method statement

Table 3 Value criteria to deliver environmental improvement and social benefit

Value criteria	Detail	Metric	Criteria type	Data source	Further information/ reference material
Strategic Environmental Assessment (SEA)	The identification and assessment of effects the proposed programme will have on the environment.	Programme benefit (score max) Programme disbenefit (score min)	Optimised	Option level assessment	Regional environmental assessment method statement
Natural capital	The calculation of increased natural capital delivered in the proposed programmes.	Enhancement of natural capital value (£m)	Optimised	Option level assessment	Regional environmental assessment method statement
Abstraction reduction	Optimisation of programmes based on the level of abstraction reduction, considering affordability, expected benefits and timing.	Reduction in volume of water abstracted (Ml/d) and delivery (date)	Optimised	Environment Agency scenarios and water company scenarios	Regional environmental ambition method statement
Biodiversity	The calculation of biodiversity net gain to assess and compare proposed programmes.	Biodiversity net gain score (%)	Optimised	Option level assessment	Regional environmental assessment method statement
Carbon	Used to show how proposed programmes seek to balance the additional carbon created, through a combination of minimising emissions, possible alternative construction techniques/materials and carbon offset schemes.	Cost of carbon offsetting (£m)	Optimised	Option level assessment	Regional environmental assessment method statement

Table 4 Value criteria to increase the resilience of the region's water systems

Value criteria	Detail	Metric	Criteria type	Data source	Further information/ reference material
Drought resilience	Ensure programmes achieve a 1in500 year resilience.	Achieve 1in500 year drought resilience (date)	Constraint	National Infrastructure Strategy and Water Resource Planning Guideline	-
Reliability	The ability to withstand short term shocks without actively changing the performance of the system.	Programme reliability score	Optimised	Resilience assessment	Regional resilience framework
Adaptability	The ability to make short-term change in performance of the system to accommodate the impact of a shock and recover.	Programme adaptability score	Optimised	Resilience assessment	Regional resilience framework
Evolvability	The ability to modify the system function to cope with long term trends.	Programme evolvability score	Optimised	Resilience assessment	Regional resilience framework

Table 5 Value criteria to deliver a programme at a cost that is acceptable to customers

Value criteria	Detail	Metric	Criteria type	Data source	Further information/ reference material
Programme cost	Representing the total cost to deliver all option in the proposed programme.	Net present value (£m) using the Social Time Preference Rate (STPR)	Optimised	Option level assessment	Regional options appraisal method statement
Intergenerational equity	The total cost of the proposed programme calculated using a lower HM Treasury rate that spreads the cost of the programme over the planning period – delivering best value for both present and future generations.	Long term discount rate (LTDR)	Optimised	Option level assessment	Regional options appraisal method statement

58. Weighting is given to the value criteria within a threshold of the least cost plan, to allow a series of optimised programmes to be developed that maintain the supply demand balance.

As such, the environmental and social plan optimises the weighted combined environmental and social value criteria metrics; the resilience plan optimises the weighted resilience value criteria metrics, and the best value plan optimises the weighted combination of all value criteria functions. Programme appraisal is undertaken across the proposed plans – reviewing and interrogating the metrics to refine the programme and develop a preferred plan across the required programmes.

59. The outputs of the investment modelling and discussion concerning our selected programmes are provided in Chapter 7.

E. Basis of planning

Planning horizon

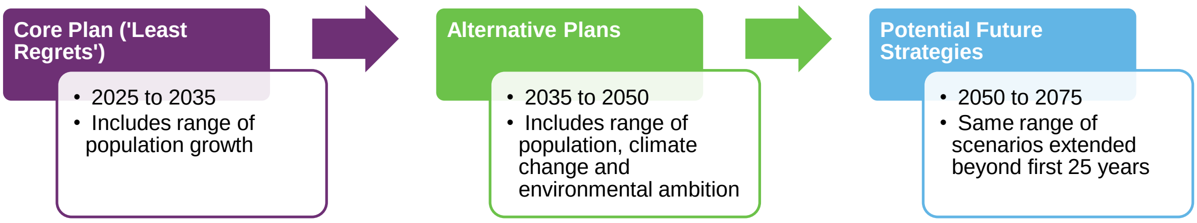
60. The Guideline requires that companies select a planning period appropriate to the risks of the company, with the minimum being 25 years. The current 2019 plan covers a 60-year period, from 2020 to 2080. For this plan, we have planned for a period of 50 years – covering years between 2025 and 2075.

61. A time period beyond the statutory minimum was selected for the following reasons:

- This extended time frame allows large scale solutions to have a similar likelihood of being selected as short- and medium-term options, so that the best value plan is produced
- To align with the planning period used across the region, and in the regional model, to ensure consistency across the modelling outputs and therefore both plans
- To improve assessments of the range of uncertainties involved over the long-term, in relation to population growth, climate change and environmental improvements

62. The regional plan is divided into three periods, to reflect the increase in uncertainty over time and therefore a change in the depth of analysis needed. Our plan, as a sub-set of the regional plan, reflects the same periods.

Figure 6 Planning horizon periods



Planning scenarios

63. We test our forecasts and system by assessing the supply-demand balance under high demand and low supply conditions. The following demand scenarios have been investigated as part of this plan:

- Normal year annual average (NYAA) – average year-round demand
- Dry year annual average (DYAA) – average year-round demand in a dry year
- Dry year critical (peak) period (DYCP) – peak period in a dry year

64. The definition of a dry year is detailed within the supply and demand forecast sections (Chapter 5). The critical period is designed to test our resilience to high demand periods,

usually experienced in early summer (May to July) due to a heatwave, such as that experienced in 2020 (and subsequently in 2022).

Levels of resilience

65. We plan to meet demand by planning to have sufficient resources so that we only need to implement demand restrictions according to a certain return period. These return periods are termed levels of service (LoS) and are effectively a standard of service we provide to customers. Our target levels of service are as follows:

- We will prohibit the use of hosepipes and unattended watering devices (temporary use bans, known as TUBs) no more than once every 10 years on average – i.e. there is a 10% risk of a TUB being required in any year.
- We will implement an Ordinary Drought Order to restrict the non-essential use of water (Non-Essential Use Bans, known as NEUBs) no more than once every 20 years on average, i.e. there is a 5% risk of an ordinary drought order being required in any year.
- We will require Emergency Drought Order measures (e.g. rota cuts, use of standpipes and phased pressure management) only in extreme droughts beyond a 1 in 500-year frequency or emergency situations, i.e. there is a 0.2% risk of an emergency drought order being required in any year.

66. In terms of comparison with the South East region, across the six companies the level of service for TUBs ranges from 1 in 10 years to 1 in 20 years, whilst NEUBs ranges from 1 in 20 years to 1 in 80 years.

67. It is important to recognise that the level of service return period is not equivalent to the drought severity return period. Having said this, demand restrictions would not generally be expected during drought events with a return period of less than 1 in 10 years. We use trigger curves as defined in our Drought Plan to inform when it may be appropriate to implement demand restrictions. With a changing climate, the frequency and magnitude of droughts will change and therefore the trigger curves that currently define levels of service may be breached more frequently in the future. We will continue to review our trigger curves in future Drought Plans to maintain our target levels of service.

68. The target levels of service are stable throughout the duration of the plan. That is, the annual risk of a prohibition or restriction on the use of water being imposed on our customers does not change over the planning period. In this plan, we have improved the level of service concerning the need to bring in Emergency Drought Order from 1 in 200 to 1 in 500 years. Therefore our level of resilience meets the 1 in 500-year planning requirement by 2039/40 as set out in the Guideline.

69. We carried out an assessment of the supplies required in a 1 in 200- and 1 in 500-year drought frequency scenario to achieve the levels of service being planned for and to provide a comparison with the current plan. However, demand restrictions are implemented on a precautionary basis as a management response in preparation for a developing drought of unknown severity and therefore their frequency will not necessarily reflect the magnitude of the ultimate drought event. We have aligned the demand reduction achieved from a TUB or drought order with that set out in our Drought Plan.

70. We plan to meet the 1 in 500-year level of drought resilience without having to resort to using drought permits (to abstract more water) that are considered to be environmentally damaging. We also expect to use drought permits not considered to be in sensitive areas, i.e. where the impact of increased abstraction is not linked to negative environmental effects, less often as our supplies will be more resilience to drought.

71. We acknowledge that achieving the 1 in 500-year level of drought resilience, and the timing of when it is reached, has cost implications which need to be considered against benefits to customers and the environment. The Guideline requires companies to develop the

design of the regional systems to be able to cope with a 1-in-500 year drought, without the need for water rationing by no later than 2040, unless it can be shown that more cost-effective solutions can be achieved by delaying achieving this standard until 2045 or 2050.

72. When preparing our draft plan, the region tested achieving the 1-in-500 year level of resilience in 2035, 2040, 2045 and 2050. Meeting the standard earlier required more infrastructure to be developed to meet the shortfall, adding increased pressure to customer bills in the short term. Delaying resilience improvement of the system increased the likelihood of customers and industry being impacted by these severe droughts. Sensitivity concerning this element of the revised (now published) plan is provided in Chapter 8.

Drought Vulnerability Assessment

73. In WRMP19 we carried out an assessment of our vulnerability to droughts and concluded we should assess our vulnerability to both the worse drought on historic record and a 1 in 200-year drought, to test which was the most challenging. When this level is close to being breached, it is expected that more serious demand restrictions and actions with the highest level of environmental impacts are carried out. This is known as 'More Before 4', in reference to the final stage of the Drought Plan - Level 4 – the point at which emergency actions such as standpipes and rota-cuts are needed because the availability of supplies is so low. For this plan we have selected to forecast water supplies using a more challenging 1 in 500-year drought risk level (also known as a 'extreme' drought) from 2040, to improve our level of resilience.

74. This type of plan is termed a 'resilience tested plan' or risk composition 2. To calculate this, a technique termed stochastics is used. Essentially this involves using a model to simulate a range of possible future droughts. As it is not based on historical records, the approach is forward-looking and means we take into account that the past may not be a good representation of the future.

75. We continually monitor and record groundwater levels, river flows, surface water storage and rainfall within our supply area. Consequently, the risk of drought and its impacts on the catchment, water resource availability and our customers can be effectively assessed, and appropriate drought measures can be implemented in good time to maintain supplies and meet our levels of service. We can also take early action to protect habitats that depend on spring and river flows, especially in the north of our area where the chalk river sources are located.

76. We monitor water levels at Bough Beech Reservoir, whilst groundwater levels are monitored at several observation boreholes (OBHs) in the chalk and greensand aquifers that we abstract from to determine whether drought triggers have been crossed relative to the time of year. The triggers are used to identify what action needs to be taken, including supply-side actions (drought permits/orders) and demand-side actions (such as usage restrictions). How we determine our drought triggers, using groundwater and surface water levels in combination, alongside other factors including customer demand, is discussed within the Drought Scenarios section of our Drought Plan.

> We have provided an overview of the legislative and regulatory frameworks that have informed our plans and explained that customer research has confirmed support for regional resource planning that goes beyond minimum requirements to ensure a long-term security of supply. We understand that customers and stakeholders see the plan as an opportunity to enhance the water environment and believe that we should develop an acceptable balance of solutions to water resource planning – avoiding a reliance on 'risky' solutions.
>
> Further engagement has informed our best value planning criteria and metrics, centred around the resilience of the region's water system, delivering a secure and wholesome supply of water, delivering environmental improvement and social benefit, and at a cost that is acceptable to customers.
>
> We have commented on levels of resilience and our drought vulnerability assessment, setting out that for this plan we have selected to forecast water supplies using a more challenging 1 in 500-year drought risk level.

SECTION 3

Section 3 Water supply

3. Water supply

In this Chapter we calculate the balance of our water supply. We consider factors that affect our abstraction and water availability, such as climate change and operational constraints, as well as our environmental ambition to reduce abstractions in the future. We provide further detail on our proposals for the Water Industry National Environment Programme (WINEP) to undertake a series of work across the areas we operate in to support resilient catchments.

A. Deployable output

1. Deployable output (DO) is the maximum average output of a source, or group of sources, taking into account constraints across the following factors:
   - Hydrological yield
   - Licenced abstraction level
   - Environmental constraints
   - Pumping capacity
   - Raw water main capacity
   - Treatment capacity
   - Trunk / Distribution main capacity
   - Water quality
2. The DO is calculated for each source or source group. In our supply area this covers 33 groundwater sources (including one spring source) and one surface water source (Bough Beech).
3. Our groundwater and surface water sources were assessed separately and in line with the UKWIR *Handbook of Source Yield Methodologies*[8] and supplementary WPRG guidance on stochastics. In both cases we carried out a full reassessment of DO, in comparison to our last plan, at both a 1 in 200-year (severe drought) and 1 in 500-year (extreme drought) event frequency. This used stochastically generated (or randomly simulated) climate data in order to predict groundwater levels and/or river flows and the reliable supplies that might be available in plausible droughts that are more severe than those experienced in the past, including those experienced in the 1970s and 1990s.
4. Appendices A & B provide additional detail on the methodology employed and the results for each source.
5. For groundwater, we carried out a company specific assessment using a lumped parameter model, as we did for WRMP19. This time we have particularly focused on updating the source constraints and revising the initial hydrological conditions to enable the DO of the two different drought severities to be calculated. However, for Bough Beech, we used a different methodology based on the WRSE regional simulator model incorporating the modelling package *Pywr* to produce a more accurate assessment in line with the other surface water DOs in the region.

APPENDIX A/B
Deployable Output Reviews

8 Handbook of Source Yield Methodologies (ukwir.org)

Groundwater deployable output

6. Groundwater provides around 85% of our supplies, from four aquifer resources units (ARUs). There have been no changes to the number of sources available since the previous plan.
   - North Downs Chalk (16 sources)
   - Confined Chalk (1 source)
   - Mole Valley Chalk (4 sources)
   - Lower Greensand (12 sources)
7. The methodology and outline results of this plan's groundwater DO assessment is given below. A full description is given in Appendix A.
8. The DO assessment relates groundwater levels to abstraction rates, to determine the most reliable sources output available over the course of a design drought. Peak DO (PDO) represents the available source output during the period of peak demand, whilst the minimum DO (MDO) represents the available source during the period of lowest resource availability, in the autumn before winter rainfall recharges the aquifers.
9. Lumped parameter models developed for key observation boreholes are combined with stochastic climatic datasets to predict groundwater levels at the set severities. Using existing scaling factors, these modelled groundwater levels were then used to provide an approximation of the water level condition at each groundwater source during the drought event. The operational drought curve for each groundwater source was curve-shifted to this water level condition and the critical constraints were examined, thereby providing an estimate of DO for this event.
10. The key purpose of undertaking individual groundwater source DO assessments is to define how each source works, the critical constraints to DO, and to define the relationship between source water levels and groundwater levels at appropriate critical period observation boreholes for use in the curve-shifting process. The process of source DO assessment also provides an opportunity to:
    - Select appropriate 'critical period' records and gauging station records (i.e. good drought indicators) to act as reference boreholes
    - Identify and rank drought years using historic groundwater level and flow records
    - Refine and review the source constraints information
    - Estimate individual source DO values for the 1 in 200-year and 1 in 500-year drought event
11. Table 6 lists the reference observation boreholes selected for the assessment.

Table 6 Reference observation boreholes

EA reference	Borehole name	Length of record	ARU	Comments
TQ25/86	Chipstead	2002-2020	North Downs Chalk	Relatively unaffected by abstraction and does not dry out. Used by the EA for national groundwater level reporting.
TQ55/1	Riverhead	1965-2020	Lower Greensand	Longest local record in this ARU but outside SES Wsater supply area

12. For this plan, we have changed the North Downs Chalk reference borehole from the Well House Inn to Chipstead OBH, in line with the Environment Agency's view that the former borehole does not exhibit the full extent of severe drought recession to be considered representative of the wider aquifer. We have also updated our Drought Plan so that Chipstead is used as the drought trigger borehole. However, for comparison purposes and to extend the time series pre-2002 using regression analysis, a model of Well House Inn borehole has been included in the assessment.

13. We have employed a lumped parameter model to generate a series of groundwater levels in response to rainfall events using climate and catchment data. The model is calibrated to observed levels and used to predict levels using different rainfall and potential evapotranspiration (PET) inputs.

14. To derive the DOs for the drought events, a hydrological frequency analysis is carried out on the stochastically (randomly) generated groundwater level data. The Environment Agency's North Down-South London hydrometric area to best reflect the catchments being modelled. The calibration data for period being modelled, from 1998 to 2018, is detailed in the technical report. In summary, calibration of the model to observed groundwater levels is reasonably good.

15. The stochastic climatic datasets comprise of 400 x 48-year timeseries and are based on the Dorking rain gauge in our area of supply, with the PET from WRSE's Thames South London dataset. The historical data underlying the stochastic data are slightly different to that used to calibrate the pumped parameter model as they represent slightly different areas. For peak DO (PDO), July was selected as the month of peak demand based on historic records of demand as well as the modelled groundwater levels.

16. The next stage of the assessment involves applying scaling factors to describe the relationship between the rest water level of the appropriate reference observation borehole and the groundwater sources. The output of this process is a set of non-pumping water levels for each source under the 1 in 200-year and 1 in 500-year event conditions. The drought curve for each source can then be shifted to this different starting point and the Minimum DO (MDO) calculated from where the curve meets the source constraint, i.e. licence, pump capacity, pump cut out or Deepest Advisable Pumping Water Level (DAPWL).

17. The results of the critical constraint to MDO and PDO, for both drought severity events, is given in Table 2.7 of Appendix A. A comparison with previous plans is also given in Tables 2.2 and 2.3 of the same report. The overall difference due to resource constraint changes since WRMP19 is a reduction of 1.7 Ml/d at MDO and 12.6 Ml/d at PDO. There are several sources where the constraint has changed. In some cases, this has resulted in a significant change in DO, for example, the application of the Abstraction Incentive Mechanism which took effect in 2020 at The Oaks & Woodcote boreholes lowered the DO by 2 Ml/d, whereas the inclusion of Outwood Lane increased DO by 3 Ml/d.

18. No sources have a constraint due to deterioration of raw water quality, as any risks identified to date that are not mitigated by ongoing catchment management work, for example through the Water Industry National Environment Programme (WINEP) schemes, are expected to be treatable.

19. It has been assumed that all time-limited licences, which affects three source sites due for expiry in March 2025, will be renewed for the duration of the plan. This is on the basis that any sustainability reductions will be included in the Environmental Destination scenarios (see Chapter 3.B).

20. The overall deployable output for groundwater sources is summarised in Table 7. There is a 3.8% decrease in MDO and an 8.0% decrease in PDO between the 2019 assessment and the current 1 in 200-year assessment. However, there is very little difference between

the two drought severity levels, showing that our groundwater sources have a similar level of resilience to both severe and extreme droughts.

Table 7 Groundwater baseline deployable output

AMP	Design drought	MDO (Ml/d)	PDO (Ml/d)
WRMP19	1 in 200-year event	188.7	265.5
WRMP24 (this plan)	1 in 200-year event	182.3	246.5
WRMP24 (this plan)	1 in 500-year event	181.5	245.4

Surface water deployable output

21. We operate one river abstraction from the River Eden, which is used to fill Bough Beech Reservoir during the autumn and winter months only (September to April). The constraint on DO is the availability of water in the river during drought years. This relates to the Dry Year Annual Average (DYAA) scenario. A Dry Year Critical Period (DYCP) scenario is not applicable as any seasonal increase in demand is met from available storage, however a PDO can be derived by multiplying the DO for DYAA by the peak (July) demand factor.

22. The volume available from the River Eden at the abstraction point is calculated using a *CatchMOD* rainfall-runoff model. A *CatchMOD* model was also developed for the Mill Stream which feeds directly into the reservoir, although this is minor in comparison to the abstracted levels. The model used includes rainfall and PET data from 2005 to 2017, which was added to the data from 1920 to 2005, so that 97 years of data was utilised.

23. Stochastically generated rainfall and PET data from a selected sequence of 78 years (including a 1 in 200-year event) was used to determine DO for a severe drought. This corresponded to the sequence used in the groundwater lumped parameter model.

24. Abstraction is simulated using an *Aquator model*. This is a component-based modelling software that includes a representation of the water supply network. It allows source constraints to be applied to individual components, such as reservoir control curves, and for the inclusion of daily flow time series. To align with the modelling work carried out for the RRP the setup of the *Aquator model* was replicated in *Pywr* (see Appendix B). The results from the groundwater DO reassessment were added to the Bough Beech *Pywr* model at a later date.

APPENDIX B
Bough Beech Deployable Output Review

25. The model was refined by considering how the network operates and any constraints to water transfers caused by sub-zonal pumping or pipe transfer capacities. The model was then validated using sets of runs with variations in network constraints, minimum treatment works outputs and considering the impacts of drought measures on demand (TUBs and NEUBs).

26. As no previous *Pywr* model was available the results were validated against operational information. DO was calculated using the 'Scottish DO method' using the same stochastic inflow series as used with the groundwater DO assessment. The constraint on DO in the 1 in 200-year and 1 in 500-year scenarios was identified as being the capacity of Bough Beech reservoir.

27. The results of the DO assessment for Bough Beech, and how these compare against the previous assessment (which is broadly comparable in methodology), are given in Table 8. For both MDO and PDO, there has been a 19.6% increase between the 2019 assessment and the latest 1 in 200-year event scenario. However, the level at the 1 in 500-year event is equal to that calculated previous for the less severe drought event, showing more

extreme droughts would have a greater impact on our surface water source than our groundwater sources.

Table 8 Bough Beech deployable output

AMP	Design drought	MDO (Ml/d)	PDO (Ml/d)
WRMP19	1 in 200-year event	17.8	21.5
WRMP24 (this plan)	1 in 200-year event	21.3	25.7
WRMP24 (this plan)	1 in 500-year event	17.8	21.5

Raw water transfers

28. We do not use any raw water transfers and therefore this element is not included in our baseline DO calculation.

In combination effects

29. Deployable output calculations were initially undertaken at individual source level, then input to the conjunctive use *Pywr* water resources model to take account of the in combination impacts of operating the sources together. Although groundwater minimum and peak deployable outputs are not represented dynamically in the model, our surface water reservoir is, and combined with a representation of our network, the model allows estimation of the availability of conjunctive supplies under defined drought conditions. Modelling showed that our company total deployable output is less than the sum of all the individual source deployable outputs.

30. The groundwater source deployable output calculation methodology does not explicitly take account of 'in combination' yield interference effects in the aquifer between sources but this is expected to be very small. There is no in combination yield effect between our surface water source and groundwater sources as the surface water reservoir and river from which we abstract is hydraulically unconnected to the groundwater aquifers from which we abstract.

31. In combination yield impacts between abstraction boreholes at a single source are taken into account but in combination yield impacts between groundwater sources are typically indiscernible and cannot be accurately determined empirically or analytically due to the complex and variable nature of aquifer recharge, groundwater storage and groundwater flow.

32. There are Environment Agency regional numerical groundwater models that simulate flow and storage within the aquifers that we abstract from. However, at the present time, they are not calibrated at the level of detail that would be required to accurately determine the small in combination/interference effects on deployable output of operating sources together and such effects are considered to be within the headroom uncertainty allowance we include in our supply-demand balance.

Overall deployable output

33. For consistency the groundwater DO is added to the regional simulator (*Pywr*) model so that the same network constraints are applied[9]. This results in an overall DO as shown in Table 9.

9 WRMP19 DO calculated by adding the groundwater and Bough Beech DO outputs together.

Table 9 Overall baseline deployable output

Plan	Design drought	MDO (Ml/d)	PDO (Ml/d)
WRMP19	1 in 200-year event	206.5	287.0
WRMP24 (this plan)	1 in 200-year event	190.8	196.3
WRMP24 (this plan)	1 in 500-year event	183.2	188.4

34. Our draft WRMP24 was the first time we have developed a groundwater-surface water conjunctive use network model which has allowed us to calculate total water resource zone DO more accurately.

35. As described above, both our groundwater and surface water deployable outputs have been calculated by applying 19,200 years of stochastically generated rainfall and evapotranspiration to our hydrological and hydrogeological models. The groundwater level minima and reservoir yield output from these models has allowed us to statistically determine deployable outputs under different annual probability metrics.

36. Deployable output calculations were initially undertaken at individual source level, and these were then input to the conjunctive use *Pywr* water resources model where the in combination impacts of operating the sources together was taken into account. Although groundwater minimum and peak deployable outputs are not represented dynamically in the model, our surface water reservoir is, and combined with a representation of our network, the model calculates the availability of conjunctive supplies for the full stochastic hydrological dataset. Total deployable output is calculated using the 'Scottish DO' system response method and is determined as the yield at which an annual return frequency of failure occurs (failure being defined as four consecutive days of being unable to meet the entire demand or storage reaching emergency storage).

37. 1 in 200-year MDO and PDO has decreased by 14.05 Ml/d and 93.74 Ml/d respectively. Approximately half of the MDO decrease is from our groundwater sources due to the calculation now using Chipstead instead of Well House Inn observation borehole (OBH) and general source DO reassessment with the remainder due to apparent constraints of conjunctive operation of the network revealed by the model. For the 94 Ml/d decrease in PDO, 24 Ml/d is from groundwater DO reassessment (7 of which is due to the switch to Chipstead OBH) and therefore 70 Ml/d is due to apparent constraints of conjunctive operation of the network suggested by the model.

38. The nature of these constraints needs further, more detailed modelling investigation and empirical verification to establish whether they are real and whether they can be removed or reduced, for example, by verifying the modelled reliance of our Horley and Edenbridge demand centres on our Bough Beech source and then investigating how these demand centres could be supplied by sources other than Bough Beech. We propose to undertake such investigations in AMP8.

The drought of 2022

39. Although the summer of 2022 was exceptionally dry, groundwater storage in our Lower Greensand and Chalk aquifers held up relatively well with minimum groundwater water levels at the Riverhead and Chipstead observation boreholes declining to annual minima in October and November 2022 that, based upon analysis of 19,200 years of stochastically generated groundwater levels for these sites, had a return period of somewhere between 1 in 2 years and 1 in 5 years. Our Bough Beech Reservoir storage dropped just below our Level 1 drought trigger but not to a level where demand restrictions needed to be introduced.

40. Allowing for implementation of both drought demand and supply side measures, we plan for current resilience to a 1 in 200-year return period drought and to 1 in 500-year resilience by 2039 as proposed by the Guideline. Resilience to even more severe droughts (> 1 in 200-year before 2039, > 1 in 500-year from 2039) is provided by drought permit options that are detailed in our Drought Plan.

B. Our environmental destination

41. As well as meeting the needs of our customers, it is equally important to us that this plan is designed to achieve enhancement of our natural landscape and the ecosystems it supports. This will also contribute to the Government's 25-year plan for the environment which committed to achieving clean and plentiful water by improving at least three quarters of our waters to as close to their natural state as soon as is practicable. This is particularly vital for the chalk river catchments in our area, due to their rarity and vulnerability.

42. Our approach has developed to move beyond the traditional method of basing environmental needs on the requirements of the WINEP which only considered the mandatory actions required in the next five years. Instead, we are planning for longer-term by modelling the implications of different environmental scenarios for our water sources. As a region, under the emerging plan we assessed between 450 and 1,200 million litres less water per day would have to be abstracted to meet Water Framework Directive (WFD) objectives.

43. In collaboration with the Environment Agency we have assessed our sources to develop potential levels of sustainability (abstraction) reductions in those catchments where flows may be considered insufficient. The EA have produced several guiding principle documents on this area for both regional groups and water companies. The requirements are summarised below:

- Complete an assessment of the abstraction reductions required to meet your agreed long-term destination and other actions to protect and improve the environment – taking into account climate change impacts and future demand
- Agree the steps needed to achieve this destination, including prioritisation (by meaningful engagement with environmental groups and regulators)
- Detail an understanding of the uncertainties associated with this and a plan to reduce those uncertainties over time

44. The approach we have taken was developed at a regional level so that we have a consistent methodology and can evaluate the impacts of the potential reductions as part of the WRSE adaptive plan. Further work is needed to better understand the impacts of abstraction and the benefits, or possible disbenefits such as flooding, that reducing abstraction will deliver, and therefore this can be incorporated in the form of different adaptive pathways. Once the results of the work are available we can determine which pathway is selected, on a catchment-by-catchment basis, with much more certainty. These investigations will be carried out under the Water Industry National Environment Programme (WINEP) and included in our next business plan(s), and thus can be used to inform the next iteration of this plan.

Development of the sustainability reduction scenarios

45. We do not have any 'confirmed' or 'likely' sustainability reductions on our licensed abstractions as identified in the current plan (WRMP19). We are currently carrying out two schemes as part of our WINEP relating to flow drivers, with further work being delivered across water quality and other drivers. The flow drivers relate to the Upper Darent and Wandle catchments (Table 10), and an investigation into low flows on the River Hogsmill concluded this year.

Table 10 Ongoing Water Industry National Environment Programmes

Catchment	No of sources	Type	Action required	Date required
Darent	1	Restoration	Adaptive management	22 December 2024
Wandle	7	Restoration	Adaptive management	22 December 2024
Hogsmill	3	Investigation	n/a	31 May 2023

46. Where the action required is *adaptive management*, which relates to measures such as weir removal, re-meandering, re-profiling, there is no adjustment needed to deployable output.

47. The second type of sustainability reduction is derived from the impact of our long-term environmental destination, based on data provided by the Environment Agency[10] following a national assessment of whether each river meets the Environmental Flow Indicator (EFI), the needs of protected areas and the future predicted abstraction. The range of scenarios, from low to high levels of ambition, ranged from ***Business as Usual (BAU)***, to ***Adapt***, ***Combine***, ***BAU+*** and ***Enhanced***.

48. These scenarios were refined in collaboration with our local Environment Agency representatives and officers, using local knowledge plus the information obtained from current and previous WINEP schemes. New ***Central*** and ***Alternative*** scenarios were developed on the basis of these discussions. The outcome of the assessments was used to derive high, medium and low scenarios, with medium defined as that closest to the arithmetic mean of selected scenarios. The results can be summarised as follows, with more detail on the impacts at a licence level shown in Table 11.

Table 11 Environmental destination scenarios

Scenario	Reduction (Ml/d)*	Eden/ Medway	Upper Darent	Wandle	Mole	Hogsmill	Selection for adaptive plan
BAU	6.09	✓		✓	✓		Not included**
Central	**11.38**	✓□	✓	✓		✓	**Low**
Alternative	**15.40**	✓□	✓	✓			**Medium**
BAU+	23.05	✓	✓	✓	✓		Not selected
Adapt	28.28	✓	✓	✓	✓		Not included**
Enhanced	**29.29**	✓□	✓	✓	✓	✓	**High**
Combine	31.37	✓	✓	✓	✓		Not included**

*Against a DO of 183.2 Ml/d in a 1 in 500-year event

**These scenarios were based on preliminary information, not refined by us and local EA team, and not included in the selection

□Groundwater only

49. These scenarios, even in the low destination pathway, would result in a significant reduction to deployable output. This demonstrates that we are strongly committed to improving the environment and have put forward a high level of ambition, with priority given towards a greater level of reduction in chalk catchments.

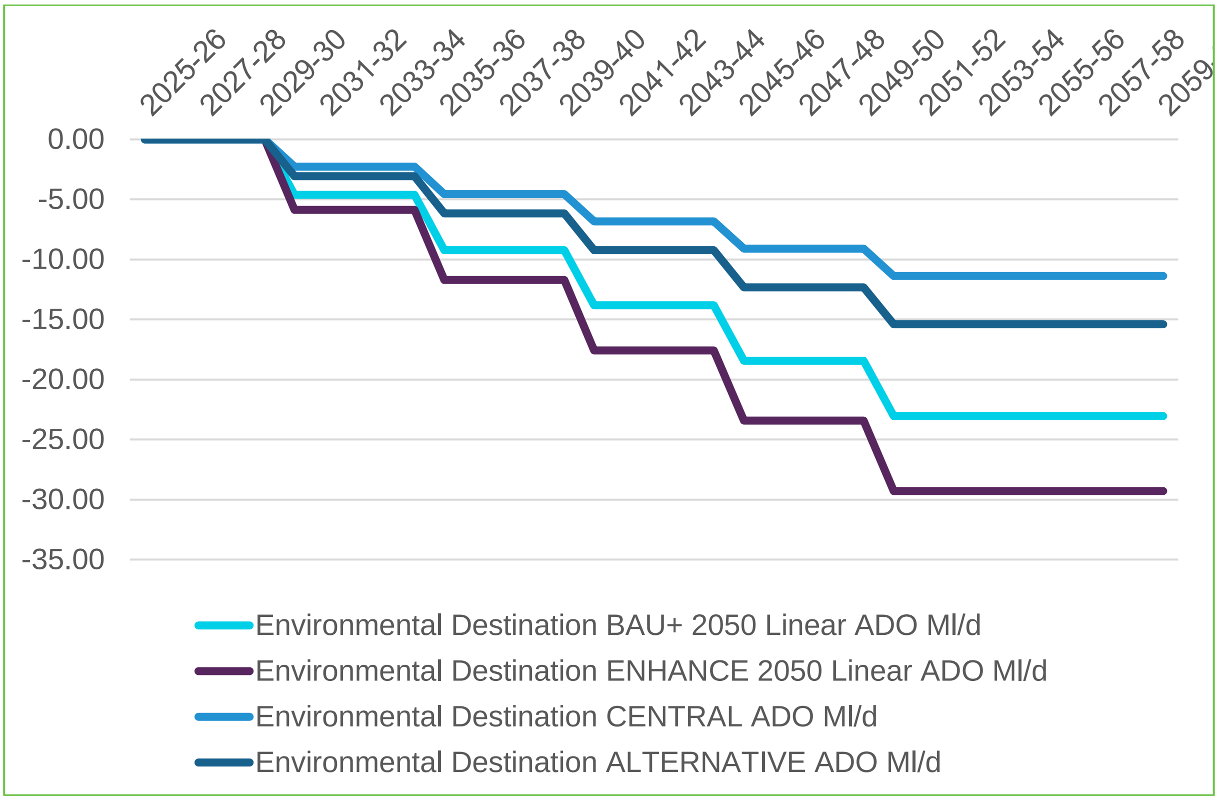
10 As part of the Water Resources National Framework

50. The phasing of the licence reductions is set on a 'glidepath' basis from 2030, when the earliest action could take place following WINEP investigations in the 2025-2030 period, through to 2050, at five-yearly timesteps, after which the reductions remain unchanged up to the end of the plan. The environmental profiles of reductions are presented in Figure 7. There are no differences in the potential sustainability reductions across the planning scenarios (such as different drought severities or average/peak conditions).

51. We acknowledge that our WRMP tables show the final abstraction reductions in 2050/51, whereas we are expected to have all environmental destination reductions in place by 2050 (2049/50 in our data tables). We are committed to achieving our environmental destination by 2050. From 2025-2027 we will be undertaking a series of WINEP investigations across our environmental destination catchments (see Table 12) that will define source-specific reductions from 2030 to meet the 2050 environmental destination requirement. We will therefore update our WRMP29 with this refined level of detail.

52. We propose to utilise available opportunities[11] to submit altered environmental destination profiles to the regional investment modelling, and thereby understand the immediate implications of the environmental destination profiles being altered to meet 2049/50. Where there are changes to the plan from 2050 as a result of this, we will consider with the Environment Agency the appropriate means of monitoring – such as through our monitoring plan in advance of drafting our next plan (WRMP29) or through an updated set of tables in the Annual Review process.

Figure 7 Environmental destination profiles (BAU+, Enhance, Central, Alternative)



Prioritisation of environmental improvements

53. At a regional level we have also worked with the Environment Agency to develop the prioritisation of reductions to achieve the best benefits, for example where we have higher certainty of restoring flows and where the impacts of low flows are more severe (such as

11 This is expected to be in early 2025 as Southern Water prepare their revised draft plan following reconsultation (11 September to 04 December 2024).

where rivers dry out completely). There is also an option to focus more on areas where people live or where rivers are less modified.

54. The outcome of this evaluation resulted in the list of factors as follows:

- Upstream first – does the catchment include headwaters
- Certainty of benefit – reducing abstraction will lead to improved flows and ecology not limited by other factors
- Scale of issue - % below flow target
- Ecological potential - inclusion of a protected area
- Benefit to people – access by population
- Natural England Nature Recovery List
- Chalk stream / river catchment

55. The results of the scoring showed that of the catchments in our area, the Darent & Cray and Wandle were the highest two scoring. Whilst this is an evolving component of water resource planning, we anticipate the scoring would inform the finalised list of catchments to be taken forward for early investigation.

Delivering our environmental destination

56. To deliver our environmental destination, and fully explore whether other abstractions are having an impact on sensitive environments, we are proposing a programme of investigations in our business plan to map out our reduced abstractions.

57. We have developed in consultation with the Environment Agency and various catchment partners our most ambitious WINEP to date for AMP8. An overview of our environmental destination and landscape proposals (relating to water abstraction) are provided below.

Table 12 Overview of environmental destination and landscape WINEP proposals (abstraction related)

Catchment/ location	WINEP proposal	Rationale
Hogsmill	River restoration project. We are also in the process of developing options from our recent investigation.	A low flow investigation (completed in May 2023) indicated in a modelled scenario that one of our abstractions could impact the Hogsmill river flow. We currently operate an augmentation scheme to support the flow of the Hogsmill River. At this stage several options to reduce our abstraction are too costly, and we would also risk moving the necessary water requirement to another sensitive catchment in the wider area. We are therefore proposing to undertake some initial river restoration work, and consider whether the augmentation can be more effective, to enhance the environment in the near term. This catchment will form part of a separate investigation (as below).
Hogsmill, Wandle, Upper Darent and Eden	Environmental destination investigation	These catchments neighbour each other across the north of our supply area, and in some of our more densely populated areas. We have committed to an environmental destination across all these catchments in this plan. The outcomes of the investigation will specifically define an achievable profile of reductions in the catchments, linked to specific sources within a

Catchment/ location	WINEP proposal	Rationale
		licence. We intend to develop an operational blueprint from this and undertaken additional network analysis so that we can understand where our network may need to be altered to enable the reduced abstractions. These outputs will be fed into our next plan (WRMP29) and the next regional plan.
Beverley Brook	Low flow investigation	We have also committed to reduced abstractions across our sources in the Beverley Brook, albeit we understand there is not a hydrological link between the groundwater and surface water. We are proposing to undertake a desk-study to explore the hydrological regime between the ground and surface waters and define an appropriate profile of reductions in response.
Regional	Environmental destination investigation	The Environment Agency have worked with the regional groups to include a regional investigation each company will feed into. Within WRSE we have proposed to use this investigation to reconcile each company's individual investigation (to ensure there is no duplication of effort) and investigate further catchments as required. We also intend to use this investigation to develop some of our supply options in more sustainable catchments so that further rounds of resource planning can include additional options to maintain our supply demand balance. For the purpose of this investigation, we believe the Mole catchment will be a focus to develop our source options.
Reigate Heath	SSSI (Sites of Special Scientific Interest) (Protected landscapes)	We have three sources and a treatment works in proximity to Reigate Heath. Whilst we do not operate those sources and the treatment works on a day-to-day basis, due to the limited capacity and reduced cost benefit, we are aware of the significance of their location to a SSSI – a protected landscape. We have included an investigation in our WINEP to explore the impacts of abstraction on Reigate Heath (SSSI) and, following the results of that investigation, will consider the operational future of those sources.

Licence capping

58. A further requirement of this plan is to address the deterioration risk from existing abstractions. Since more water is licenced than actually used in many cases, there is a perceived risk that growth in demand could cause environmental damage – even if abstraction remains within licenced constraints.

59. An assessment of this risk has been carried out by the Environment Agency on all our licences, by comparing the maximum peak and annual average volumes abstracted over a six-year period from 2010 to 2015 with the following six-year period 2016 to 2021. Criteria are applied to each catchment to determine if a licence change is required and whether this should be set at average or peak abstraction rates. Any changes should be progressed through the WINEP process, with no growth in abstraction (i.e. capped) until the WINEP options appraisal is concluded.

60. We have carried out an analysis of the licences that meet the Environment Agency criteria on licence capping and compared the reductions to those included in our environmental destination scenarios to calculate whether there are any additional impacts. The outcome of our discussions with the Environment Agency outlined that our licences that met the preliminary criteria should be scoped out due to the type of groundwater body (such as confined chalk which is not hydraulically linked to the surface waters) or where the water was used for augmentation of rivers only, and therefore we do not have any licences where the cap should apply.

61. We augment both the River Wandle and the Hogsmill River, which as chalk (or chalk fed) rivers. This forms part of our licence conditions, providing a constant base flow from the start of the river that helps to protect the ecology – particularly during summer and autumn when the springs are not normally flowing due to lower groundwater levels.

Enhancing the environment beyond reduced abstractions

62. Ongoing engagement with our customers and stakeholders has demonstrated continued support for us to go further with our work to enhance the environment. We have planned a suite of work in our WINEP beyond our environment destination – aimed at managing historical pollution risks affecting our sources, understanding more recent pollution risks and protecting certain species from our operations.

63. Such catchment management work can improve the water quality in the environment and of abstracted water, thereby leading to improved or more resilient habitats and reduced water supply treatment requirements. However, water quality improvements can take a long time to take effect, particularly on groundwater water quality due to the typically slow nature of groundwater flow. Therefore, any recovery of, or improvement to, catchment water quality and abstracted water from catchment measures is unlikely to be immediate. Due to this uncertainty, it forms part of our uncertainty or 'headroom' allowance rather than being an assumption in our baseline supply forecast.

64. We have also developed our first non-statutory[12] piece of work under the 25 Year Environment Plan focusing on the Eden Catchment and our Bough Beech reservoir.

65. Our 25 Year Environment Plan WINEP is a catchment-based investigation aiming to quantify catchment pressures and appropriate mitigation/partnerships[13] across the catchment. Pressures include:

- Increasingly flashy river with limited sustained flow during our permitted abstraction
- Quality issues surrounding chemicals and dissolved oxygen
- Local flooding across the catchment during heavy rainfall, resulting in reduced agricultural productivity, soil erosion, and road contaminants entering land and water
- Built environment planning for projected population growth and housing/service needs
- Near-term support to neighbouring water companies, coupled with a potential raising option of the Bough Beech reservoir (and the associated expenditure and embodied carbon).

66. Our ambition for the Eden catchment is to define a series of nature-based solutions and interventions we can undertake with various partners to alleviate these pressures. For us,

12 Customer support is required to support non-statutory proposals. Our business plan (PR24) customer research has confirmed clear support for our catchment proposals. We are therefore also aligned with Ofwat's public value principles.
13 Key stakeholders (and potential partners) include the Environment Agency, Natural England, Ofwat, local planning authorities, WRSE, Southern Water, the agricultural sector, SERT, local wildlife trusts and the built environment sector.

we are aiming to achieve a more sustained river flow, as part of an improved water system[14] – with the potential to develop our abstraction protocol – and better water quality at source.

67. The outcomes of this investigation, and subsequent work across the catchment, will feed into our future WRMP cycles. This is with a view to developing source options that have a balance across nature-based solutions and, where required, built infrastructure; and ultimately work towards reducing our reliance on new water storage and embedded carbon.

Biodiversity and invasive non-native species (INNS)

68. Biodiversity enhancement and effective management of invasive non-native species is a key element of our environmental responsibility and estate/catchment management.

69. In addition to being the only water company to pursue a bespoke performance commitment in AMP7 to manage elements of three of our land holdings in such a way to achieve the Wildlife Trust's Biodiversity Benchmark, we are proposing to nominate a significant proportion of our land into Ofwat's PR24 biodiversity common performance commitment. This will enrol nominated land into a 25-year commitment to deliver improved biodiversity. We consider there is additional opportunity to elect further land into the commitment, relating to our wider catchment work, over forthcoming business plan cycles.

70. We are separately required to assess whether our current or future abstractions and operations will risk spreading invasive non-native species. Potential pathways could be from raw water transfers or changes to existing impoundments such as weirs. *This risk is not expected to be significant but is being assessed as part of our final plan work.*

71. As part of our ongoing WINEP we have completed a company-wide investigation to identify the presence of invasive non-native species and have a management plan in place. We are now working through the second investigation to prepare a strategy report across the potential pathways across our site operations, including from non-water transfers.

72. We have provided plans in our PR24 WINEP submission to undertake continued monitoring of invasive non-native species and install facilities at our Bough Beech reservoir site to manage the potential spread of known species to other sites. Further facilities to this operational area will also include the installation of eel screens where we abstract from the River Eden. We have previously completed a full optioneering and feasibility study to assess the appropriate means to comply with the Eel Regulations and submitted a proposal within our PR24 WINEP.

C. Impacts of climate change on supply

73. We have carried out an assessment to quantify the impact on climate change on the availability of water supplies and therefore deployable output. Additional information on the climate change methodology is available from the WRSE draft regional plan.

74. The first stage is to complete a Basic Vulnerability Assessment to climate change. This showed that the vulnerability of our supplies was 'Low'. This has not changed from the previous assessment in 2019.

75. The climate change scenario work was carried out by at a regional level by Atkins, using the latest national datasets released, known as UKCP18 projections, from the Met Office[15]. This is an update from the data used for WRMP19, which were termed UKCP09, and there are some differences in methodology between the datasets as well as more recent data being included. The core messages from UKCP18 are very similar to UKCP09, with hotter,

14 A key aim of Defra's Integrated Plan for Water is to transform the management of the whole water system.
15 [UK Climate Projections (UKCP) - Met Office]

drier summers and warmer, wetter winters becoming more likely in a climate change impacted future. This does not necessarily result in less water being available.

76. The *Updated projections of future water availability for the third UK Climate Change Risk Assessment* (HR Wallingford, 2020) provided a set of UK-wide water availability projections on a catchment basis based upon UKCP18 Climate Projections. However, to determine the potential impacts of climate change on the deployable output of our individual sources, we used adjustment factors developed by WRSE based upon the same UKCP18 Climate Projections to perturb inputs to our hydrological models and in turn develop a range of climate change supply forecasts.

77. It is not possible to derive a 1 in 500-year severity climate change impacted drought directly from the UKCP18 data, and therefore the calculation involves the use of perturbation factors – rainfall, potential evapotranspiration (PET), temperature and flows – associated with a given climate change scenario which are then applied to baseline records, either historical or stochastically generated.

78. The perturbed records are subsequently fed into a water resources model to calculate the deployable output under that level of climate change. For our groundwater sources we used the perturbation factors generated from the WRSE model to input into our own lumped parameter model as detailed earlier. However, for Bough Beech we utilised the Regional Simulation Model to determine climate change impacts from the same perturbation factor data.

Generation of climate change factors

79. UKCP18 generated a range of increasingly extreme scenarios termed RCP2.6, RCP4.5, RCP6.0 and RCP8.5. It also produced a scenario consistent with the 'medium' level scenario in UKCP09 for comparative purposes. To demonstrate the range of uncertainty, probabilistic projections are produced with 3000 samples of factors available for every time slice and at 25km grid squares, although these are not spatially coherent. Other projections were produced, including at a global scale from 1900 to 2100, which were spatially and temporally coherent. There are 28 timeseries available, using either the *Coupled Model Intercomparison Project (CMIP)5* ensemble or Met Office *Hadley* model, both of which are deemed plausible and equally likely to occur.

80. Atkins were commissioned by WRSE to take the global projections and downscale them using a *Regional Climate Model (RCM)*, for 12 out of the 15 scenarios from the Met Office Hadley model, at a resolution of 12km^2. Any bias in the data was corrected. This work was completed for all regional groups so that there are matching (coherent) datasets for application to any transfers between regions.

Climate change impacts of groundwater deployable output

81. Investigation of the impact of different climate change scenarios on groundwater deployable output is explained in detail in Appendix A.

82. For our groundwater sources, the monthly climate change factors generated from the 12 RCM scenarios and also the 28 *Global Climate Model (GCM)* scenarios were used to perturb the historic climate record (areal rainfall and PET for South London) for input into the lumped parameter models for the Chipstead and Riverhead observation boreholes (OBH) for each climate change scenario. More details on this are given in Appendix A.

83. The factors were used to perturb the stochastic climate record for the 1 in 500-year event, as identified by frequency analysis. From this, climate change groundwater level series were produced for each of the *RCM* and *GCM* scenarios, from which the average scenario or central estimate was extracted for use in the DO assessment. The results, shown in Figure 8 (extracted from Appendix A), show the impacts are relatively small, with a slight negative effect on the minimum DO levels compared with a slight positive effect on the maximum DO. A breakdown of impacts by source is shown in Appendix A (Tables 3.2 and 3.3).

Figure 8 Impact of climate change on groundwater deployable output

	MDO			PDO		
	DO total (Ml/d)	DO impact (Ml/d)*	DO impact (%)	DO total (Ml/d)	DO impact (Ml/d)*	DO impact (%)
1 in 500 year baseline	181.50	-	-	245.38	-	-
RCM scenarios						
Min CC DO	180.63	-0.87	0%	244.60	-0.78	0%
Max CC DO	182.45	0.95	1%	248.33	2.95	1%
GCM scenarios						
Min CC DO	179.42	-2.08	-1%	242.74	-2.64	-1%
Max CC DO	182.82	1.32	1%	250.05	4.67	2%

*climate change scenario minus baseline. Negative indicates reduction in DO

84. Groundwater source deployable outputs are not represented dynamically within the conjunctive use model but the calculated climate change impacts on groundwater source deployable output are relatively small, ranging from -1.1% to +0.8% of MDO and -1.1% to +1.9% of PDO, with average impacts across all climate change scenarios -0.2% at MDO and +0.04% at PDO.

85. Given the complexity of dynamically representing groundwater source DOs in the conjunctive use model and their limited sensitivity to climate change, they were fixed in the model throughout the planning horizon without any profiling of climate change impact.

Climate change impacts on Bough Beech

86. As described above, Bough Beech DO was calculated using the *Regional Simulator Model (RSM)*, by taking the data from the existing *Aquator* model derived for WRMP19 and using it to populate a *Pywr* model. The results were coupled with the DO results from the groundwater sources and the demand centres across the whole supply area.

87. To assess the impact of climate change, the models were re-run using the same climatic datasets produced by Atkins as detailed above in Chapter 3C, using the 'English and Welsh DO method'. Each replicate was assessed separately and the demand in the zone scaled up until a single failure in a demand centre occurred. The DO is calculated as being one step below that failure point. The results were aligned with the baseline DOs to identify matching return period events to identify the effect on DO in a consistent way to baseline. This was repeated for each of the 21 replicates to calculate the impacts of every potential climate change scenario up to the 2070s, using the 50th percentile.

88. As the assessment was carried out across the whole system, the results are expressed in terms of overall impact instead of separating Bough Beech from the groundwaters. However, by calculating the difference between the results it can be inferred that the effect of climate change on Bough Beech DO is higher than the impact on groundwaters. The

River Eden, used to fill Bough Beech Reservoir, is already a flashy river and more intense storms due to atmospheric warming will reduce the number of days where the flow is above the hands-off flow condition and therefore the number of days abstraction is permissible. The hands-off flow condition is the minimum flow required before abstraction can take place, to protect the river ecology.

Overall climate change impacts on deployable output

89. The climate change impact on the total Company DO, but effectively on Bough Beech Reservoir, was calculated by perturbing the rainfall and potential evapotranspiration inputs to the conjunctive use model's surface water component and determining the resultant change in DO for each climate change model. The resultant climate change impacted Company-level DOs were then provided to WRSE to include in the regional adaptive planning investment model.

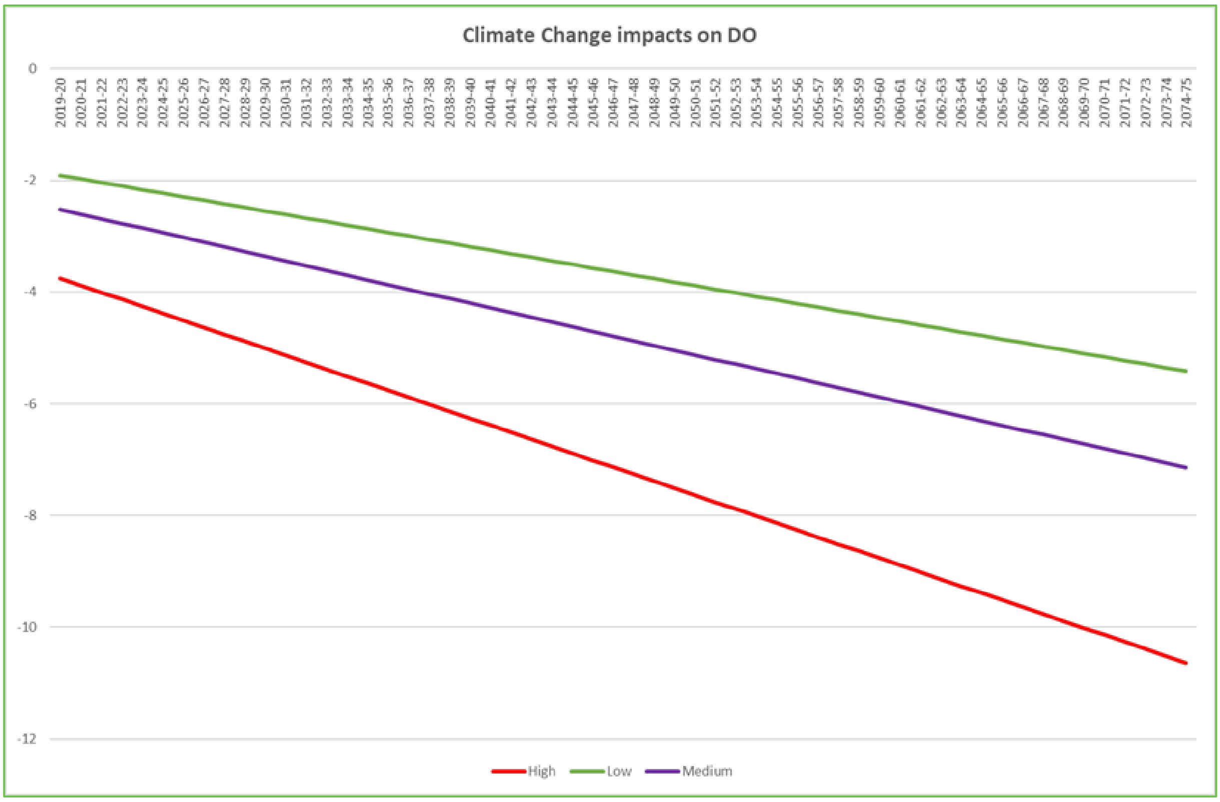
90. The outcome of selected climate change assessments, chosen to represent low, medium and high scenarios, are summarised in Table 13. Medium is calculated as being the median of the 28 scenarios.

Table 13 Climate change impacts on ADO by 2050 and 2070 (median of the 28 scenarios)

Scenario	1 in 200-yr – 2049/50 (Ml/d)	1 in 500-yr – 2049/50 (Ml/d)	1 in 200-yr – 2069/70 (Ml/d)	1 in 500-yr – 2069/70 (Ml/d)
Low	- 5.38	- 3.83	- 7.17	- 5.10
Medium	- 6.66	- 5.04	- 8.88	- 6.72
High	- 9.70	- 7.51	- 12.93	- 10.01

91. The results from the whole time period up to 2075 are shown in Figure 9. This shows clearly that the impacts are gradual and also there is a more of a decline in DO under the high emissions scenario.

Figure 9 Climate change impacts (Ml/d) under low, medium and high emissions scenarios



92. The same assessment was completed under the peak planning scenario, with the results shown in Table 14. It is noticeable that the difference from the average to peak DO is more pronounced in the higher drought severity scenario.

Table 14 Climate change impacts on PDO by 2050 and 2070

Scenario	1 in 200-yr – 2049/50 (Ml/d)	1 in 500-yr – 2049/50 (Ml/d)	1 in 200-yr – 2069/70 (Ml/d)	1 in 500-yr – 2069/70 (Ml/d)
Low	- 5.34	- 2.92	- 7.12	- 3.89
Medium	- 6.88	- 4.31	- 9.17	- 5.75
High	- 9.52	- 6.16	- 12.69	- 8.21

93. The initial vulnerability assessment was then re-examined in light of the results. This showed the classification of vulnerability is low to medium with the potential for some investment to be driven by climate change. This means that appropriate UKCP18 datasets should be used to build the evidence base on the scale of the impacts. We have met this criterion given the inclusion of the UKCP18 spatially coherence data in conjunction with the stochastic data and range of scenarios tested against.

94. For adaptive planning purposes, up until the second situation branch in 2040, the median of these climate change scenarios is selected as agreed with WRSE. From 2040 onwards, the high projection (scenario CC06) and low projection (scenario CC07) are also used as alternative scenarios so that greater climate change uncertainty is explicitly considered

later in our planning horizon. Uncertainty of climate change impacts on supply prior to 2040 is taken into account more broadly in our target headroom calculation (Chapter 5B).

95. To avoid double counting of climate change impact uncertainty, the climate change component of target headroom is removed from the base data used to develop the adaptive planning branches after 2040 and replaced by explicit consideration of the upper and lower climate change scenarios referenced above by the adaptive planning process.

Summary of deployable output

96. Other components which impact on baseline DO include raw water transfers (imports or exports) or confirmed sustainability reductions. We do not have any of these components, therefore the only change to baseline is that due to climate change. Table 15 shows how the overall values compare with the previous assessment for WRMP19, based on the medium climate change scenario.

Table 15 Baseline average deployable output (ADO) compared to WRMP19, 1in200 year scenario

Plan	Time slice at 2049/50	Time slice at 2069/70
Final WRMP19	202.60	202.00
WRMP24 (this plan)	184.01	181.75
Difference	- 18.59	- 20.25

97. There is a significant decrease in deployable output between the two plans arising from a decline in the baseline deployable output and higher climate change impacts.

98. When compared against the other drought frequency scenarios, as shown in Table 16, deployable output is only impacted marginally by drought severity, especially between the 1 in 200-year and 1 in 500-year drought frequencies. By 2070 the differences are more significant due to the increasing effect of climate change (based on medium level impacts).

Table 16 Baseline average deployable (ADO) – all drought scenarios

Event scenario	Time slice at 2029/30	Time slice at 2049/50	Time slice at 2069/70
1 in 100-year	191.54	188.85	186.17
1 in 200-year	186.27	184.01	181.75
1 in 500-year	187.38	178.07	176.36

99. Under the peak period scenario, baseline deployable output is as shown in Table 17. The volumes are between 4 to 7 Ml/d higher than average conditions.

Table 17 Baseline peak deployable output (PDO) - all drought scenarios

Event scenario	Time slice at 2029/30	Time slice at 2049/50	Time slice at 2069/70
1 in 100-year	196.83	193.85	190.87
1 in 200-year	191.68	189.37	187.06

Event scenario	Time slice at 2029/30	Time slice at 2049/50	Time slice at 2069/70
1 in 500-year	193.47	184.16	182.75

D. Raw water and treatment works losses

100. We have assumed the same estimates on the amount of water lost between each abstraction point and the point that the water leaves the treatment works as was completed for the WRMP19, since there is no significant investment planned to reduce losses during the current five-year period.

Raw water losses

101. Raw water losses are those between the point of abstraction and the water treatment works (WTW), assumed to be mainly due to leakage on raw water mains. These were re-assessed based on a review of meter records, with total losses calculated to be 2.5 Ml/d.

102. The losses figure has been applied to both the average and peak planning scenarios within the draft plan. It has also been assumed that the figures will remain constant throughout the planning period. However, we are currently reviewing options for our next business plan which may result in upgrades being made. This component may therefore need reviewing in subsequent iterations to ensure consistency with our operational works.

Water treatment works losses

103. These are losses that occur through the works, including leakage from pipes and structures, non-recovery of washwater, water lost through sludge exports and operational use such as sampling. It is calculated by using the difference in metered flow between the WTW inlet flow meters and the WTW output flow meters (known as DI meters). As we supply process water from the distribution mains (i.e. downstream of the DI meters), these flows must be taken into account in the analysis.

104. The results of the assessment for both average and peak conditions are that losses are 4.95 Ml/d. It has been assumed that these losses will remain constant throughout the planning period, although as with raw water losses we will re-assess this assumption as we confirm our next business plan and in future iterations of this plan for continued consistency.

Outage

105. An outage is a short-term loss of deployable output, with short-term defined as three months or less. These must be accounted for within the supply forecast. Outage can be considered as either planned or unplanned.

106. Planned outages typically result from the need to maintain the serviceability of source works, including inspection works, planned maintenance activities, and refurbishment or repair of plant that leads to a temporary loss of water supply. Unplanned outages are interruptions to supply caused by unforeseen events including pollution events, power failures, and system and equipment failures.

107. The outage allowances have been derived at a regional level with reference to the Guideline using the principles set out within the UKWIR (1995) report *Outage Allowances for Water Resource Planning*. The regional approach has involved assessment of each WTW in terms of potential outage type, duration, magnitude, and frequency using a common modelling tool produced by Mott Macdonald, named *WRSE Outage Common Platform*.

108. Within this, a modelling technique (Monte Carlo simulation) is used to produce probability distributions of the events, based on frequency, duration and magnitude, so an overall outage allowance can be calculated[16].

109. The outage assessment was based on a review of historical outage events starting from 2007, and categorised based on planned vs unplanned and the cause – electricity failure, system failure, water quality or other. The on-site storage of treated water at each works is taken into account when reviewing the loss of output. Where further detail was required on individual events, this was discussed with operational personnel. The outage events are distributed across all treatment works, but with highest levels at Elmer and Bough Beech WTW.

110. A risk assessment model was created to derive outage estimates for both average and peak demand periods. Planned outage events such as routine maintenance works to treatment works are normally undertaken outside of the peak period to limit impact on available supplies; therefore, planned outages were excluded from the peak outage assessment.

111. The Monte Carlo model provided outage estimates for both dry year average and dry year peak periods for a range of different percentile (%ile) values. The 95%ile represents the level of outage that would only be exceeded once every 20 years, or that there is a 5% likelihood of the outage level being exceeded. This is the level used in the outage allowance for this plan and is consistent with WRMP19.

112. The results of the assessment are given in Table 18. It shows there has been a decrease in average outage in both average and peak conditions.

Table 18 Outage allowances

Plan	DYAA Outage (Ml/d)	DYCP Outage (Ml/d)	DYAA Outage (% of DO)	DYCP Outage (% of DO)
WRMP19	8.10	3.61	3.75	1.22
WRMP24 (this plan)	4.47	2.75	2.40	1.25

113. We do not consider it necessary to include any options to reduce outage to resolve a supply-demand deficit for water resources planning, and we have assumed that the outage allowances remain constant throughout the planning period. However, in our current business plan (PR19, AMP7) we made provision to maintain our treatment works so that unplanned outage is kept to a realistic minimum (of 2.3% of peak week production capacity) by 2025, to improve resilience. Similarly to the components above, we will reassess outage in further iterations of this plan to ensure continued alignment with confirmed activities as part of regulated business plan (PR24).

Water available for use (WAFU)

114. The results of the assessments of DO, climate change, raw water and treatment works losses can be combined to give a value of water available for use (WAFU), as shown in Table 19. This represents the supply forecast at a 1 in 500-year drought severity, which is the scenario which we have planned against.

16 Outage Method Statement (WRSE, July 2021)

Table 19 Water available for use (by 2069/70)

Scenario	DO (with climate change)	Raw water & WTW losses	Outage	Raw water exports	WAFU
DYAA (1 in 200-yr)	181.75	7.45	4.47	0.00	169.83
DYCP (1 in 500-yr)	187.06	7.45	2.75	0.00	176.86

We have assessed the level of water available for use (WAFU) by calculating the deployable output of our sources and taking into account losses from outage, leakage from raw water mains and treatment works usage.

We considered two simulated scenarios – under a 1 in 200-year and 1 in 500-year drought severity and assessed the impacts of climate change under these scenarios. The WAFU under average conditions is calculated to be just under 170Ml/d by the end of the planning period.

We have detailed the measures we are taking in response to the obligations we have under the Water Framework Directive to support the sustainability of our abstractions. We have outlined our proposed work with the Water Industry National Environment Programme to achieve our environmental destination and undertake further improvements to the catchments we operate in. This could reduce the amount of water available for supply by 15.4 Ml/d under the medium level scenario.

SECTION 4

Section 4 Demand for water

4. Demand for water

This Chapter covers our forecasts of population and consumption across household and non-household sectors, including how climate change impacts consumption. We assess additional demands of water, such as operational use, leakage and exports. We also detail of impact of our levels of service on demand.

A. Baseline demand

1. This section sets outs current and forecast demand under normal year and dry year planning scenarios, including an assessment of peak demand in a dry year. Demand is equal to Distribution Input (DI), which is the level of water put into the distribution network from the water treatment works with a slight adjustment to account for changes in service reservoir levels.
2. DI is calculated according to the following formula

$$DI = household\ demand + non\ household\ demand + leakage$$
$$+ distribution\ operational\ use + water\ taken\ unbilled + exports$$

3. As with the supply forecast, DI is adjusted to take account of the impacts of climate change and is based on design drought scenarios.

Defining 'Normal Year', 'Dry Year' and 'Critical Peak' demand

4. In order to forecast future demand, we explore the relationship between DI and climatic factors to inform our assessment of 'normal' and 'dry' years. The methodology used is taken from the UKWIR report *Household Consumption Forecasting,* working under the same approach as our current plan, WRMP19. More detail is given in Appendix C.
5. Rainfall and temperature can have a strong influence on customer demand for water. During the summer months, rainfall reduces customer demand from outside activities. Conversely, drought conditions accompanied by sustained periods of high temperatures, particularly over weekends and bank holidays, can lead to rapid increases in demand, mainly for garden watering.
6. The first stage to determine the normal year annual average (NYAA), dry year annual average (DYAA) and dry year critical period (DYCP) factors is to assess recent summer temperature and rainfall data using a quadrant plot, as shown in Figure 10. A judgement is made as to which is the hottest and driest year in the top left quadrant; in the case of this assessment 2003/04, 2004/05, 2005/06 and 2016/17 appear the strongest.

APPENDIX C
Demand Forecast

Figure 10 Quadrant plot for determining the dry year

7. Stage two is to analyse the per capita (person) consumption (PCC) trends, as shown in Figures 11 and 12, with measured and unmeasured consumption analysed separately to account for differences in trends and impact. Measured customer values are deemed to be more accurate and less variable in comparison to unmeasured customers. Based on this, 2003/04 stands out as the year that responds the strongest out of the three possible dry year selections discussed above (shown in light blue in Figures 11 and 12).
8. The dry year factor is calculated by removing the chosen response year 2003/04, calculating a trend line through the remaining points, and dividing the chosen response figure by the modelled figure. Our assessment results in a 'dry year factor' of 1.085 – in essence demand is 8.5% higher in a dry year. This is similar to the factor derived for the current plan (WRMP19), being 8.3%, which was also based on 2003/04. Measured normal year factor is 0.994 and unmeasured normal year factor is 1.043.

Figure 11 Reported PCC trend (measured properties)

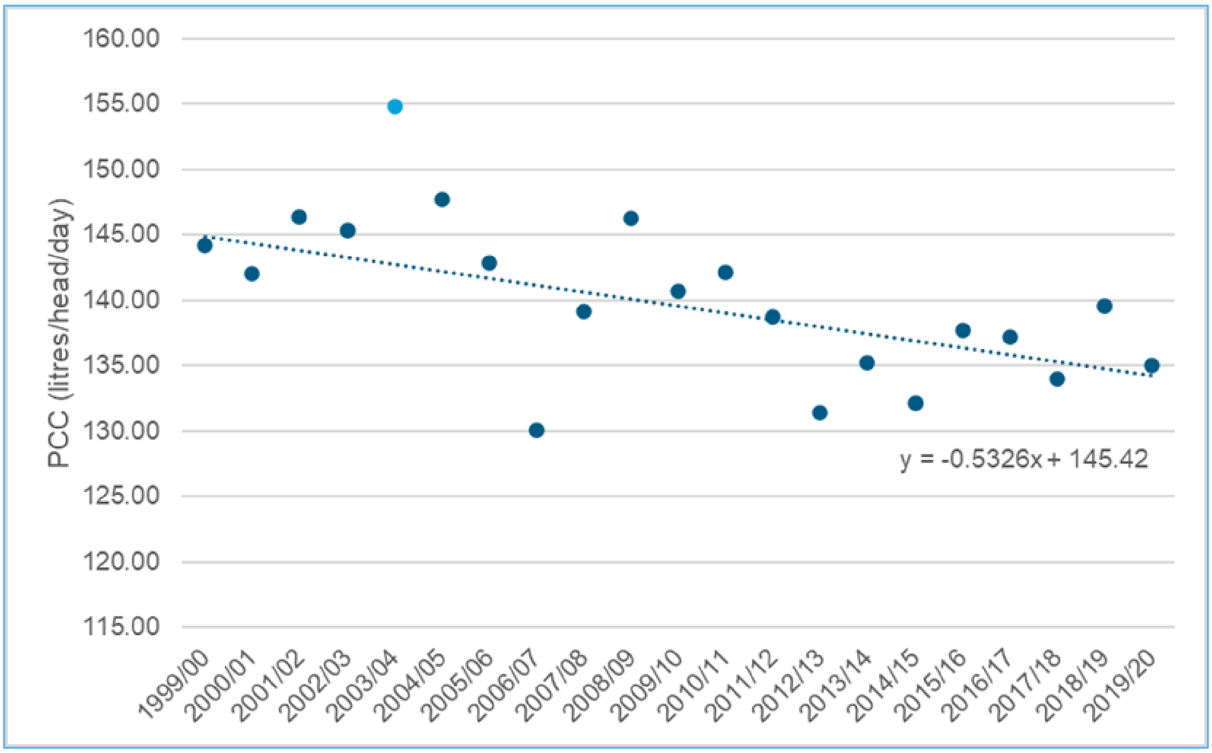
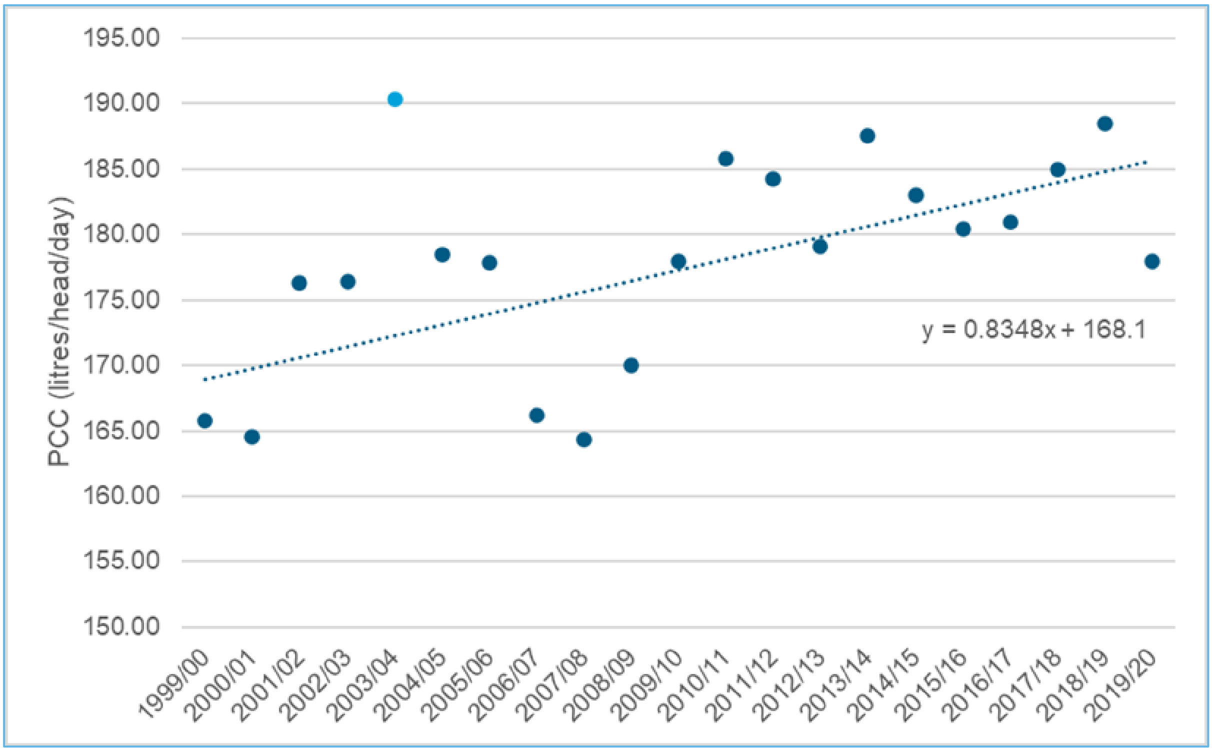


Figure 12 Reported PCC trend (unmeasured properties)



9. The Guideline requires companies to assess the ability of their sources to meet peaks in demand as well as those experienced on an annual average basis. The remainder of this section details the process we have used to define a peak period and calculate the appropriate peak factor to apply to normal year annual average demands. This is used to calculate demand for the critical period supply-demand balance.

10. Critical period calculations are completed in accordance with the methodology stated in UKWIR report *Peak Water Demand Forecasting Methodology*, as required by the Guideline. From the daily DI data a weekly rolling mean, peak week and annual average demand are calculated. A long-term annual average is then calculated for all years in the time series, and the critical period peak week factor is the maximum peak week within one of the dry years (i.e. in the top left quadrant). For this plan, the peak week was selected from 2003/04, with a peak factor of 1.474 (47.4%). This is slightly lower than the value used in the current plan (WRMP19) of 1.492.

11. A summary of the NYAA, DYAA and CP factors is given in Table 20. Application of these factors to the household demand forecast is detailed in Appendix C.

Table 20 Summary of factors applied in the household forecast

Factor	WRMP19	WRMP24 (this plan)
Normal to dry year factor (all households)	8.3%	8.5%
Base to normal year factor (measured households)	-2.1%	-0.6%
Base to normal year factor (unmeasured households)	1.8%	4.3%
Normal to critical period factor (all households)	49.2%	47.4%

1 in 200-year and 1 in 500-year drought event factors

12. The peak week factors for the two drought events were generated by the consultancy Artesia as part of the regionally commissioned demand forecast analysis to model Dynamic Demand. These factors were incorporated into the household consumption forecast in the DYAA and DYCP factors. For the 1 in 200-year scenario the factor was 1.26, whereas for 1 in 500 year the factor was 1.29.

B. Household demand forecast

13. Household consumption is forecast by multiplying the projected population with the forecast per capita consumption in each year of the planning period, starting from the base year (2019/20). The methodology and results are described in Appendix C, with a summary provided in the following sections. We maintained a consistent approach to our forecasting with the region[17].

APPENDIX C
Demand Forecast

Population and properties

14. Together as a region we commissioned Edge Analytics to forecast household population and properties (dwelling) numbers for the whole of the south east, and also the Oxford-Cambridge (Ox-Cam) Arc. The Arc is a significant new potential housing growth area which would impact on the region, although it is mainly located outside of our boundary. Their report is provided as part of Appendix C (see Level 2 Appendix A), together with an annexed update from 2023. 25 sets of forecasts were produced, with outputs provided at census level (ward) output and water resource zone level:

APPENDIX C-A
Population Growth Forecast

- Trend-based projections (based on official statistics – Office for National Statistics (ONS) and Greater London Authority (GLA)
- Housing-led forecasts (based on Local Authority Plans, GLA and OxCam)
- Employment-led forecasts

17 Demand Forecast Method Statement (WRSE, August 2021)

15. Forecasts were produced to 2049/50, with alternative growth scenarios extended to the end of the planning period using the Office for National Statistics (ONS) data (low, principal and high growth) using their demographic forecasting model, Vicus. The household population comprise of people living in both households and communal establishments ('population not in households'). An assessment of hidden and transient populations was also completed to include migrants, short-term residents and second addresses. Visitors are not included.
16. The trend-based forecast is based on census and population projections published by the ONS and GLA using different years from 2014 to 2018, as each assessment uses slightly differing assumptions which impact the outcomes. Occupancy rates are calculated using average household size data from the 2011 Census. Assumptions on migration are included.
17. For the plan-based forecasts, Edge Analytics used their *Consilium* database to enable to collection and processing of each area's latest adopted or draft plan on housing growth. Different forecasts were produced including Housing Need (what the population requires), Housing Plan (planned delivery taking land supply into account), and Completions (based on historic rates of growth).
18. The relationship between housing growth and population change is determined by the changing age-structure of the population, projected occupancy, a vacancy rate plus the changing size of the population not-in-households. The vacant property rates derived from the trend-based forecast was also used in the plan-based forecast. The general 'ageing' of the UK population results in a reduction in average household size, although since the financial crash of 2007/08 has led to a reduction in the rate at which young adults are able to form new households.
19. Edge Analytics produced housing-led forecasts using both a 'top-down' and a 'bottom-up' method, with the latter taking account of micro-level housing intelligence and therefore is more accurate in the likely spatial distribution of new housing developments. Therefore the bottom-up forecasts have been used in the Housing Plan population figures to form the basis of this forecast.
20. The employment-led forecast takes into account the link between economic growth and household property growth, on the basis that upward trends can be constrained by market conditions. Trend-based occupancy rates are applied to the economic household forecast to derive a population forecast, although economic forecasting within the current political and social environment is particularly challenging even over the short term. Results from the Office for Budget Responsibility (OBR) are used, including a coronavirus reference scenario derived from the effect of Covid19 on GDP. Two forecasts have been produced, at different potential growth levels.
21. The range of scenarios were reduced down to between three and six forecasts, to allow for a sufficient range of uncertainty to be assessed but within a practical number for modelling purposes. The selected growth forecasts produced for the plan are set out in Table 21.

Table 21 Population scenarios selected for modelling

Scenario	Forecast
Baseline	Housing-Plan-P (bottom-up)
Maximum	ONS-14-H
Median	Housing-Need-L
Minimum	ONS-18-Rebased-L

Scenario	Forecast
Completions-5Y-Principal	Completions-5Y-P
Housing Need High	Housing-Need-H

22. The results of selected projections are shown in Figure 13, which incorporates a regional update arranged for the population forecasts in 2023.

23. This displays a wide range of forecasts, especially in the period after 2050 due to the uncertainty from both trend-based and plan-based models. The results from the six selected population scenarios for modelling at 2025, 2050 and 2075 are shown in Table 21.

24. These results exclude the hidden and transient populations, which are the same for all scenarios, and are provided separately in the table. The percentage increase in population by 2075, in comparison to the 2019/20 level, is also denoted provided.

Figure 13 SES Water household population forecasts (selected projections)

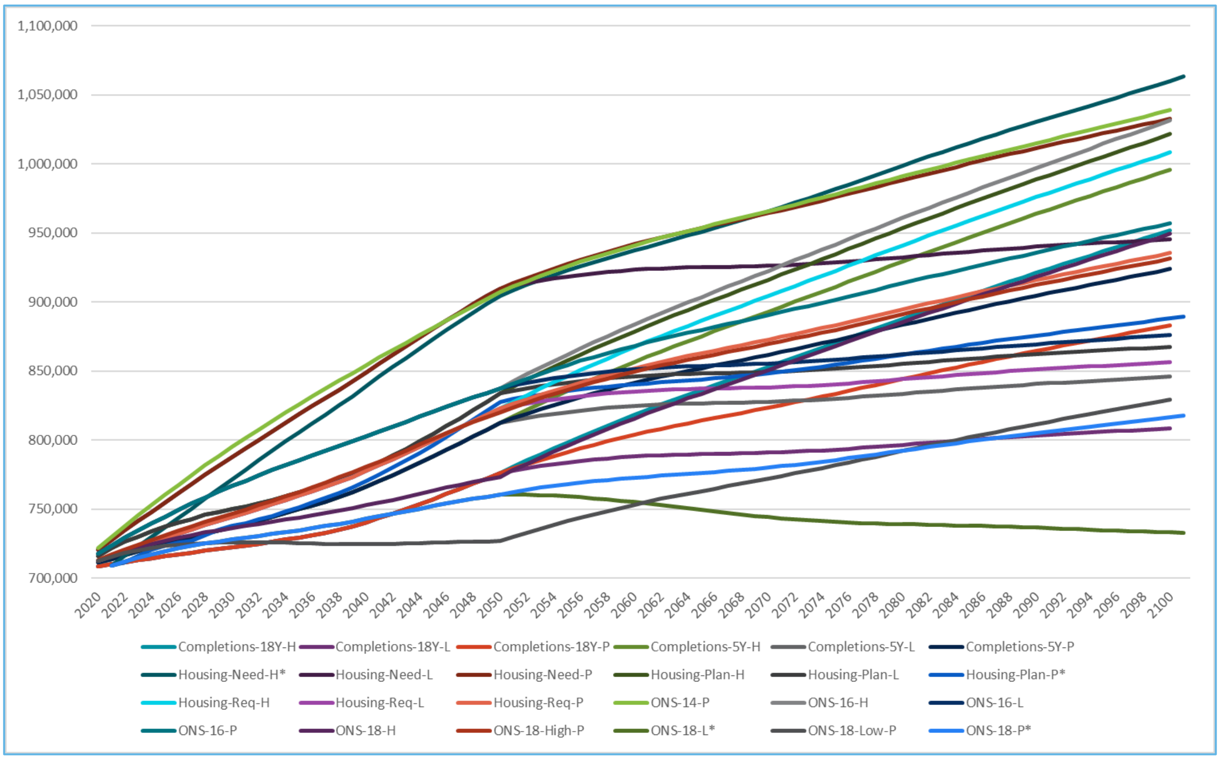


Table 22 Results from selected population scenarios

Scenario	2025	2050	2075	% increase by 2075
Baseline (Housing Plan P*)	723,665	827,670	854,499	17.5%
Maximum (Housing Need H*)	736,909	904,542	981,678	35.0%
Median	754,878	909,838	928,636	27.7%

Scenario	2025	2050	2075	% increase by 2075
(Housing Need L)				
Minimum (ONS18-L*)	719,587	760,631	740,721	1.8%
Completions-5Y-P	724,564	812,438	872,257	19.9%
Housing Need H*	736,909	904,542	981,678	35.0%
Hidden and transient (medium forecast)	10,980	10,980	10,980	n/a

25. The projected figures are then aligned to our reported base year customer numbers. An adjustment is made to account for those properties not captured on our customer database, for example where individual dwellings are not billed separately.

26. Together with the regional companies we arranged for an independent assessment of suitability of the forecasts developed. This assessment outlined that the work is a thorough and well-documented analysis providing the best available demographic and property forecasts[18].

Household consumption

27. The second part of the household demand forecast is to consider factors that affect consumption trends on an individual property and person (capita) basis. We commissioned Atkins to compete this analysis for this plan, using an updated version of the model used in WRMP19, as detailed in Appendix C. Our demand forecast has been rebased on the 2021/22 reporting year, which has allowed us to update our demand model based on recorded data since Covid-19.

APPENDIX C
Demand Forecast

28. The model uses a micro-component approach as sufficient data was available and it is more advanced than using a macro-component method. This is deemed suitable based on our problem characterisation analysis (later set out in Chapter 7).

29. To establish a baseline consumption at a household level, per capita consumption (PCC) from the water balance analysis for the base year is multiplied by the reported occupancy figures, using the Mean Likelihood Estimate (MLE) method of calculation[19]. This resulted in a post-MLE measured household consumption of 362.7 litres per property per day (356.8l/prop/day before rebasing), with unmeasured households using 456.9 litres per property per day (425.5l/prop/day before rebasing).

30. To forecast future trends, total consumption must be divided into its components and each forecast by combining values for ownership, volume per use and frequency of use. The main components are toilet flushing, personal washing, clothes washing, dishwashing, external use and miscellaneous internal use including plumbing losses, although these are sub-divided where necessary for the forecast.

31. In brief, we used the following data sources:

- National studies (such as the UKWIR study using the *Siloette* system and WRc study using *Identiflow*) to provide measured information on water use per component on a limited number of properties

18 Population and Property Forecasts Developed by Edge Analytics for WRSE for Resource Planning in PR24, An Assessment of Suitability, May 2023
19 In line with Ofwat consistent methodology for PR19.

- Customer surveys such as our online water savings calculator GetWaterFit to provide estimates of water use per component on a large number of properties
- Information from Defra's Market Transformation Programme (MTP) to provide predictions of water use for different appliances based on the effects of changes in technology, policy and behaviour trends.
- Metering savings as calculated for WRMP19

32. Since the metering status of a household property has a significant influence on consumption, we segment the properties. This is partly due to the difference in occupancy rates between the categories, as customers that opt to have a meter tend to be lower in occupancy (hence they benefit from switching from a charge based on a fixed rate per property). This has the effect of reducing occupancy in metered households, and correspondingly increasing the occupancy rate of properties remaining as unmeasured.

33. Micro-component analysis is completed for both measured and unmeasured properties, taking into account AMP7 targets, forecast trends and the baseline level of water efficiency programmes set at the level of 0.09 Ml/d each year as used in WRMP19.

Impact of climate change on demand

34. Climate change impacts on consumption have been calculated in accordance with the UKWIR report *Impact of Climate Change on Water Demand (2013)*. The climate change factors in the WRMP19 model were reviewed and it was concluded that no changes were required to the factors used.

35. Median percentage climate change impacts on household demand at 2040 relative to 2012 have been published for each river basin within the UK. Our supply area sits entirely within the Thames basin.

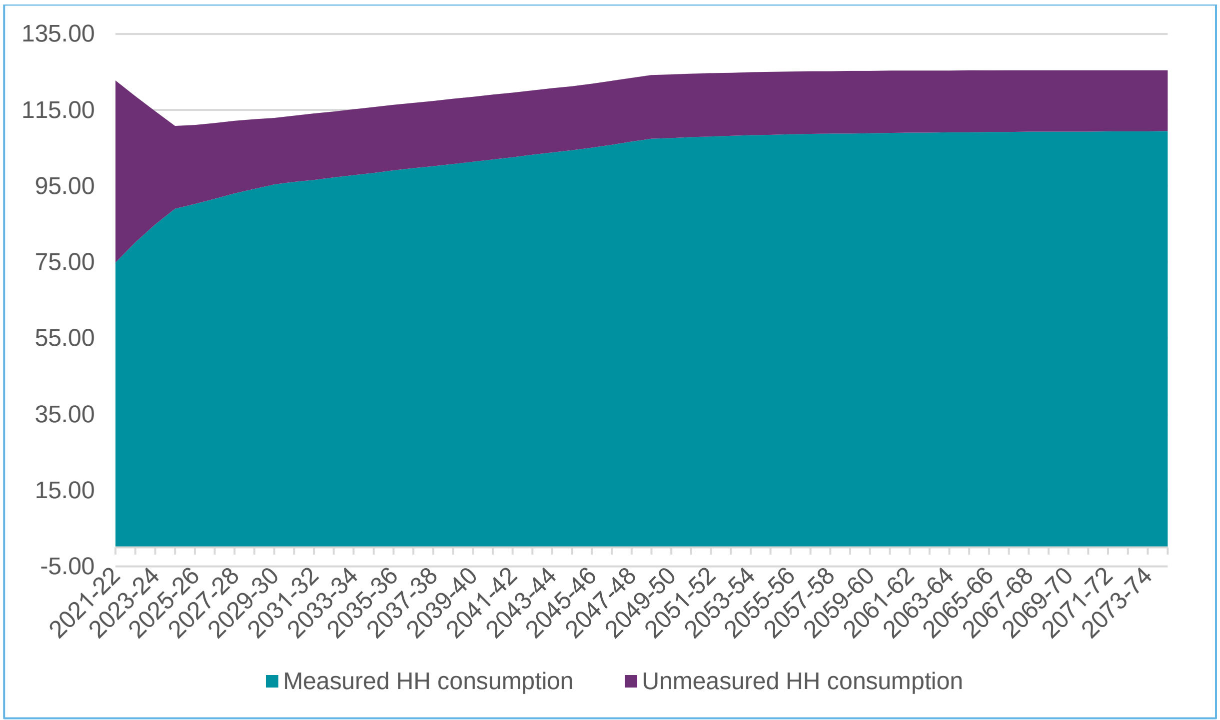
36. The dry year annual average demand and the dry year critical period demand were forecast to increase by 0.9% and 2.4% respectively, over that period due to climate change. As the base year is now 2019/20 and the final forecast year is 2074/75 the percentage change is shifted along and projected to the final planning year as there has been no further evidence since the previous report.

37. The predicted impact by 2074/75 is 1.9% for the DYAA scenario. Under a critical period scenario the percentage is 5.0%. When the critical period is selected, the appropriate climate change factor is applied in a linear fashion across the forecast period. The additional demand from climate change is added to the external use micro-component only.

Household demand forecast

38. By combining the property and population forecasts with the data from the micro-component consumption analysis, we have forecast average dry year household demand to increase from 110.86 Ml/d in 2024/25 to 125.42 Ml/d in 2074/75, as shown in Figure 14. This represents a rise of 13.1%.

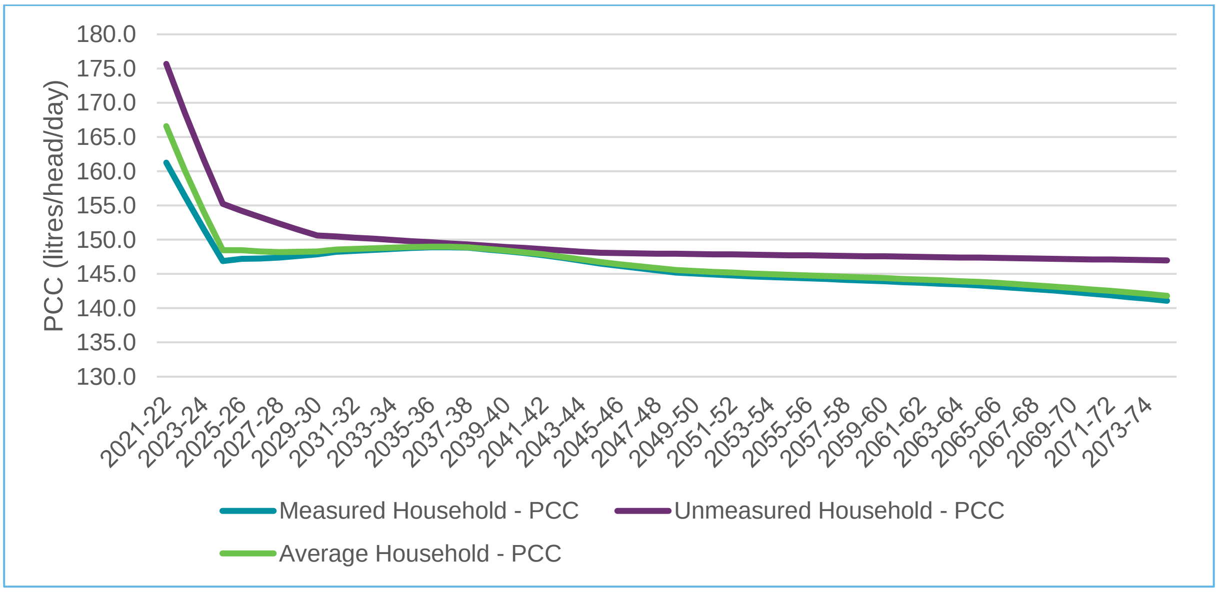
Figure 14 Baseline household consumption (DYAA)



39. We can also view baseline consumption by per capita consumption (PCC), as displayed in Figure 15. The relatively dramatic reduction up to 2025 is due to our ongoing water efficiency work (such as metering) being used in the demand model.

40. The reduction in PCC over the remainder of the planning horizon explains why overall household consumption rises at a much lower rate than housing growth. The overall dry year PCC starts at 148.5l/head/day in 2024/25 and reduces to 141.8 l/head/day per day by 2074/75 – a 4.5% decrease.

Figure 15 Baseline per capita consumption (DYAA)



41. We have also forecast household demand during the peak period, using the factors discussed in the Chapter.

Figure 16 Baseline household consumption (DYCP)

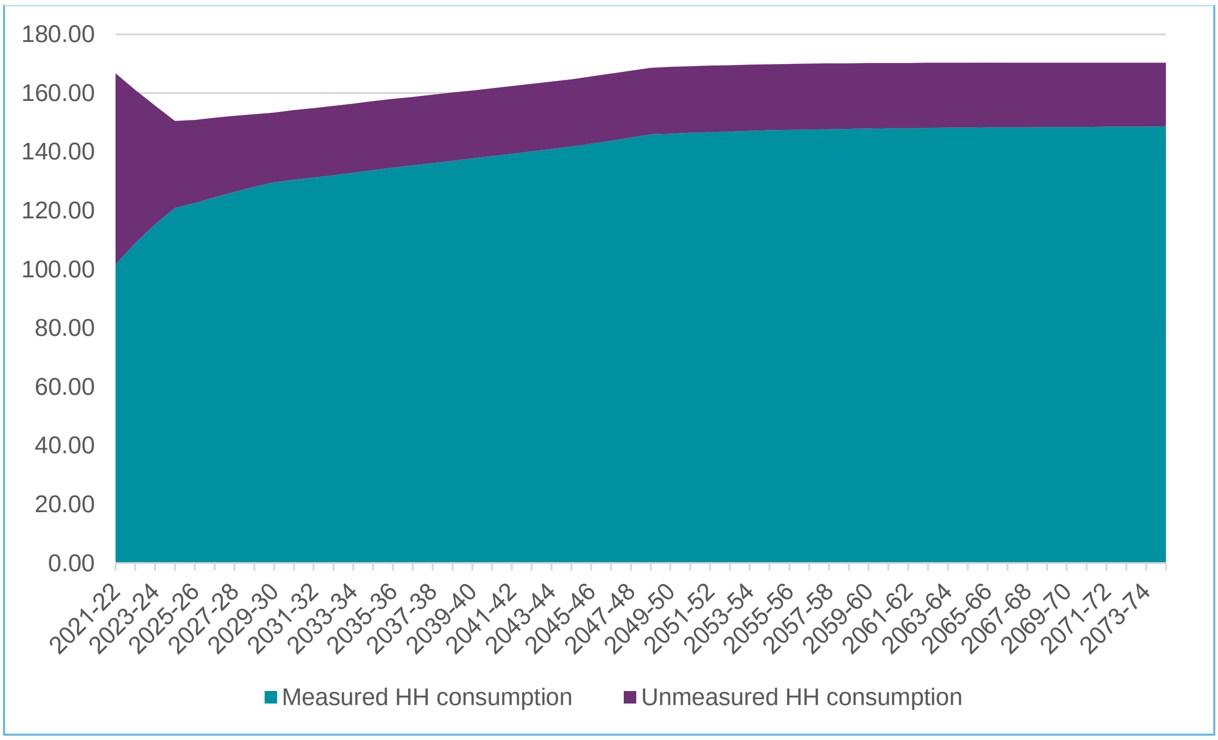
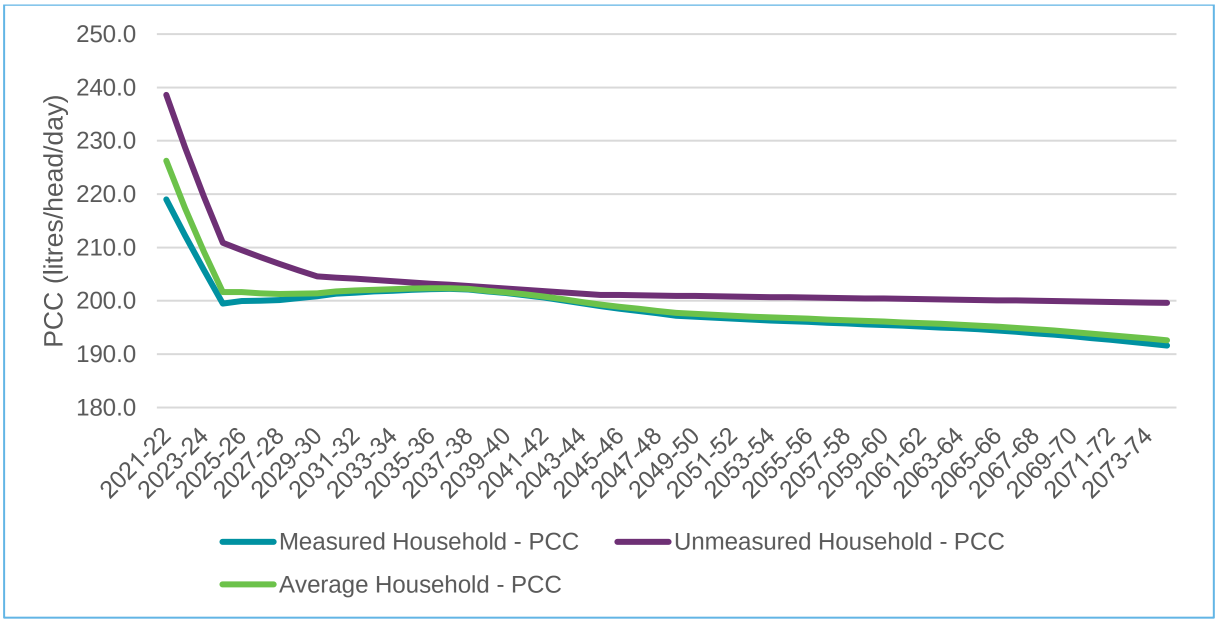


Figure 17 Baseline per capita consumption (DYCP)



42. The household consumption forecast in a dry year critical period is shown in Figure 16. This modelling results in a peak demand of 170.4 Ml/d by 2074/75. In terms of PCC (shown in Figure 17), this drops to 192.6l/head/day, from 201.6l/head/day in 2024/25 – a decline of 4.46l/head/day over the planning horizon.

C. Non-household demand forecast

43. For this plan, we commissioned Artesia as a regional group to carry out a region-wide assessment of non-household and non-public water supply demand. Artesia were asked to produce four forecasts, based on low, central and high demand, as well as a baseline. For the plan we used the baseline forecast up to 2024/25 and the central forecast thereafter. For more details on this forecast see Appendix C.

APPENDIX C
Demand
Forecase

44. As with the household demand forecast, the first stage is to assess property numbers, split into types, and then estimate the consumption per property for each type or sector. A non-household growth forecast update was undertaken in 2023 but this was inconclusive across several regions, including our area. We have therefore maintained our forecast on the draft plan material.

Non-household population and properties

45. Artesia used source data from the Central Market Operating System (CMOS) for the period 2017 to 2020, and company billing system data such as the AddressBase classifications, to segregate the properties into sectors that are likely to have different underlying drivers for consumption. These are:

- Agriculture and other weather-dependant sectors
- Non-service industries
- Service industries (population driven)
- Service industries (economy driven)
- Unclassified

46. Large non-household properties, such as Gatwick Airport in our supply area, are forecasted separately. The results, excluding large users, are shown in Table 23. Since the percentage of properties is equal to the percentage of consumption for each sector, the average consumption per sector must be similar. The vast majority of properties are in the service sector, including population-driven groups such as hospitals and schools, and economy-driven groups such as shops and offices.

Table 23 Proportion of non-household by sector (at 2019/20)

Industry sector/grouping	Proportion of properties	Proportion of consumption
Agriculture	2%	2%
Non-service	14%	14%
Service – population	26%	26%
Service – economy	55%	55%
Unclassified	3%	3%

Non-household consumption

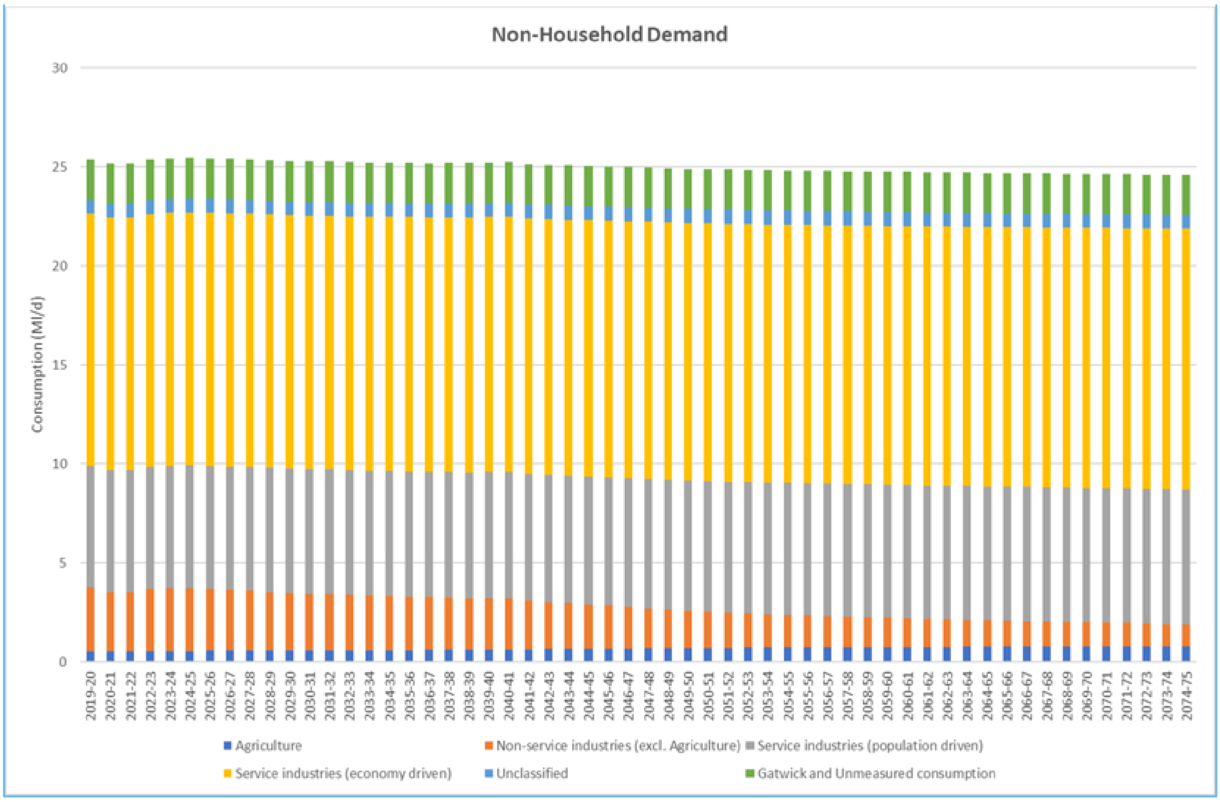
47. Artesia carried out modelling using the relevant factors, or ‘explanatory variables’, for each sector as detailed in Appendix C (see Level 2 Appendix B). For the sector which is weather dependant, climate change impacts using the dataset from UKCP18 are included. For population-driven sectors, the Housing Plan P forecast from Edge Analytics was used for the central scenario, in line with the baseline household growth projection, with the Housing Need projection used for the upper forecast and completion-5Y used for the lower scenario.

APPENDIX C-B
Non-household
Demand
Forecast 2020-2100

48. For all sectors, the impact of baseline water efficiency was set at the recommended level in the National Framework of a reduction of 4% by 2050. The impacts of Covid-19 and Brexit on population and the economy were also assessed in the forecasts. Under the lower demand scenario, ongoing negative impacts of both Covid-19 and Brexit were included. Employment estimates were taken from government reports from the Treasury in 2016.

49. The result of the modelling shows a slight decline in demand over the planning period from 25.4 Ml/d in 2024/25 to 24.6 Ml/d in 2074/75. The most significant decrease is from the non-service industries which includes manufacturing. Gatwick and the unmeasured non-household consumption are assumed to remain constant over the forecast period at 2.03 Ml/d.

Figure 18 Non-household demand by sector (central forecast)



50. Table 24 shows the range of demand between the Lower, Central and Upper forecasts at selected timeslices. This shows that by the end of the planning period, non-household demand could range from -10.6% to +11.5%.

Table 24 Summary of non-household consumption

Year	Lower forecast (Ml/d)	Central forecast (Ml/d)	Upper forecast (Ml/d)
2019/20 (base year)	25.28	25.37	25.45
2024/25	22.39	25.44	24.67
2034/35	22.21	25.22	25.01
2049/50	21.07	24.91	25.77
2059/60	21.41	24.76	26.67

Year	Lower forecast (Ml/d)	Central forecast (Ml/d)	Upper forecast (Ml/d)
2074/75	21.99	24.61	27.43

D. Bulk supplies and NAVs

51. In our draft plan we set out the bulk supplies and New Appointed Variations (NAVs) we had in place. This included two bulk supplies to Southern Water, as follows:

- A small transfer at Rusper of 0.001Ml/d to support several properties during some operational works. This has since ceased in operation (during 2023).
- A second transfer in Crawley which commenced in July 2021 at 0.3 Ml/d and increased to 0.9 Ml/d in August 2022. We do not currently expect the Crawley transfer to continue to be operational by the start of the new planning period although we are liaising with Southern Water concerning the requirement of a separate transfer volume. We detail this in Chapter 7.

52. We also detailed we provide supplies to two NAVs within our supply boundary. These are to existing or proposed housing developments. As these agreements commenced in 2021 and 2022 and our demand forecast for WRMP24 was originally developed in 2020, the demand from the NAV is assumed to be accounted for in our baseline demand forecast through our population growth forecasts. Future NAVs are unknown but are not considered to increase demand beyond the demand forecast. Future NAVs would be a reallocation of demand within the water balance, rather than new demand. Therefore, future NAVs are considered to be accounted for in the current demand forecast.

53. Since providing our Statement of Response and further information to Defra, we have been requested to detail our bulk supplies and NAVs at their contractual volumes in our planning tables. We have therefore included all known arrangements as at the end of August 2024 in our planning tables for information. These can be viewed in Table 1 (with some additional information) and together in Table 3.

E. Leakage

54. We estimate leakage in the distribution system by monitoring our 355 discrete District Metered Areas (DMAs) using remote, battery powered loggers. In early 2022 we completed an ambitious project to replace all of our network loggers, swapping out GRPS technology for new NBIoT loggers. This formed part of our **iDMA intelligent network** project with the principal driver of reducing leak runtime and leak impact.

55. Each logger records at an industry leading frequency giving us average flow/pressure data every one minute, and this data is transmitted every 15 minutes to a data server. The data forms a daily profile, including a minimum night flow that can be used as an indication of leakage in the DMA. It is sent to our leakage reporting software to enable leakage targeting and calculation of leakage against the regulatory target. Over 95% of data loggers are available for leakage calculation and near real-time network monitoring each day. This level of coverage gives us a high level of confidence in our leakage assessment and gives us constant 'eyes and ears' on the network to respond to events.

56. Since March 2022 our network data has also been routed to our intelligent network software, which uses artificial intelligence (AI) to make real time predictions of flow and pressure. Using our 24-hour control room this software alerts us to deviations from those predictions so we can make instant responses to leakage outbreak. This is dramatically reducing leak runtime, saving water loss in some cases by up to 50% and preventing or

mitigating customer impact due to burst mains and the associated supply interruptions or poor pressure that they can cause.

57. In addition to our intelligent network project for leakage reduction we have also invested heavily in another important project called DMA Asset Health. This project combines non-invasive condition assessment of our mains network with a holistic appraisal on each DMA in our network to fully optimise the network. Outputs include: network optimisation, pressure reduction, network calming and targeted mains renewal. The project is yielding excellent leakage savings of between 10-15% per DMA and is a key part of our leakage reduction and management strategy.

58. We are currently conducting our third and final stage of satellite leakage surveying. This has yielded some good results, helping us to drive leakage to lower levels than seen before in the 2021/22 report year. Although we are concluding this round of satellite-enabled leakage identification and reduction, we will look to repeat this activity periodically on the basis of results from our exercises conducted since 2020/21

59. One of the biggest challenges we face when estimating leakage is distinguishing between leakage and increased demand at night during the summer months due to sprinkler or irrigation usage, which is common in our supply area. Up to 2016/17, we assumed a leakage level during the summer months based on average levels. From 2017/18 we moved to using the Ofwat consistent methodology. This has involved a step change in recording and calculating leakage, including improved accounting of non-household night-time usage and household plumbing losses. From 2020/21 we are fully compliant with the new methodology.

60. The reported level of leakage in the past 10 years is shown in Table 25. From 2020/21 the performance commitment moved to a 3-year rolling average and therefore annual targets no longer apply. As the last line in the table shows, we out-performed our 3-year rolling average target for 2019/20 to 2021/22 by 0.8 Ml/d.

61. As expected, leakage is influenced by weather conditions with levels increasing during cold spells and also during rapid thaw periods. As an example, 2012/13 was a benign year with winter temperatures only dropping below freezing for 37 days (as measured at Bough Beech), compared to an average of 61 days, and therefore the leakage was low in that year at 23.74 Ml/d. We see a similar impact on leakage in times of hot dry conditions when soil moisture deficit leads to ground heave. In cold winters and hot dry summers, we have to invest additional funds in Active Leakage Control (ALC) in order to meet the target. However, our asset strategies see us looking to mitigate this impact in the future by increasing the resilience of our network to these shock events.

Table 25 Leakage levels since 2010/11

Year	Leakage (Ml/d)	Target (Ml/d)
2010/11	24.5	24.5
2011/12	23.6	24.5
2012/13	23.7	24.5
2013/14	23.9	24.5
2014/15	24.2	24.5
2015/16	24.2	24.4
2016/17	24.3	24.3
2017/18*	25.8	24.2
2018/19	25.0	24.1
2019/20	24.8	24.0
2020/21	25.0	No annual target
2021/22	21.1	No annual target
2022/23	22.8	No annual target
Average (past 3 years)	*22.9*	*23.64*

*Change to Ofwat onsistent methodology from this year, back-calculated in 20/21.

62. Our leakage target for the AMP7 period is a gradual decline from a 3-year rolling average to 22.1 Ml/d, a reduction of 15% from our business plan baseline. In AMP7 our approach to leakage control involves employing a combination of ALC, pressure management and mains replacement intervention strategies. We recognise that a balance of approaches is needed to reduce leakage in the short term at best value for money but which also considers the more effective and appropriate way to keep leakage low and continue to reduce it into the future.

63. Following the Leakage Routemap work, commissioned and completed by Water UK in 2022, we have embraced the concept of developing adaptive pathways in helping us to achieve our leakage reduction goals.

64. Some further examples of our interventions in AMP7:

- In ALC, we operate a performance detection contract where our leak detection contractor is paid solely on measured reductions in night flow rates which incentivises efficient performance. We also assess leakage from service reservoirs, for example through the use of drop tests during maintenance work, and trunk mains;
- Our Network optimisation and pressure management programme is driven from our DMA Asset Health project and is helping us to optimise pressure in the network to create calmer conditions that best serve our customers needs and prolong the life of ours and our customers assets.
- In AMP7 we have also pioneered a new data-led approach to mains asset renewal using non-invasive condition assessment technology with a leakage reduction driver at its core.

65. The options available to continue to reduce leakage in the future is discussed as part of the options assessment in Chapter 6.

Baseline leakage forecast

66. As per the Guideline, total leakage should remain constant from 2025/26 to the end of the planning period. Our current plans (WRMP19 and 2020-2025 business plan) have an expected level of leakage of 21.3 Ml/d at the end of the final year of AMP7, and therefore this figure is used as the baseline level. Although there is an increase in housing, it is assumed we will be able to manage our network without allowing leakage to rise, partly as this will be offset by an increase in metering penetration which is expected to reduce supply pipe leakage.

67. We assume unmeasured properties have an average of 40 litres per property per day lost through supply pipes, against an average for measured properties of 20 litres per property per day. We evaluated these assumptions by benchmarking these levels against other companies and by analysing data from leak repair records. It was concluded these assumptions were reasonable, and therefore the same estimates of supply pipe leakage have been used in this plan.

68. Options for varying our leakage management policy in order to target a lower level of leakage are considered as part of the options appraisal (Chapter 6). The economic modelling and programme appraisal undertaken to derive our preferred final planning programme considers whether options for leakage reduction are necessary and justifiable, including taking account of financial, social and environmental and carbon costs and benefits, as well as other wider factors including guidance issued by regulators and the results of customer engagement on our PR24 business plan. New leakage targets for the AMP8 period will be set by Ofwat as part of its Final Determination in 2024.

69. To assist with this appraisal, we commissioned Artesia to review our Sustainable Economic Level of Leakage (SELL), the level at which the financial costs of further leakage reduction are equal to the financial benefits of the water saved. This compares the costs of leakage detection and repair versus the marginal cost of supplying water. This is contrasted with the minimum achievable leakage (known as MAbL) for each DMA. The new SELL was calculated to be 105 litres per property per day and is higher than the previous estimate used in WRMP19 but is based on robust data collected during the 2021/22 report year.

70. The revised level of SELL has been used in the appraisal of leakage reduction options where the cost of interventions are considered alongside other demand reduction strategies. The fact that SES Water leakage (particularly in the 2021/22 year) has been assessed to be operating well below the economic level of leakage (ELL) and on a steeper section of the leakage cost curve means that leakage reduction interventions are less likely (from a cost perspective) to be selected than they were in WRMP19.

F. Distribution system operational use (DSOU)

71. In WRMP19 a figure of 2.64 Ml/d was used for DSOU, based on an estimation of water used for process water, reservoir cleaning, maintenance, and flushing purposes. This is based on a revised assessment carried out in 2015. Process water is that used at our treatment works for chlorination, ammoniation and sulphonation. Flushing is the water removed from the distribution network for water quality or new mains commissioning reasons. The results for 2019/20, used as the baseline forecast is shown in Table 26.

Table 26 Components of distribution system operational losses (2019/20)

Component	Usage (Ml/d)
Process water at WTW	2.64
Reservoir cleaning and maintenance	0.07
Mains flushing for water quality and mains commissioning	0.02
Total	**2.73**

72. This shows that the previous forecast is largely in line with current levels. It is assumed that these losses do not vary throughout the planning period, on the basis that the main components (process water and reservoir cleaning and maintenance) are fixed, i.e. they do not change in proportion to our distribution input. We are also trialling approaches such as robotic cleaning of service reservoirs that, if successful, would reduce the need to take them out of service periodically.

G. Water taken unbilled

73. We have used the level calculated in 2019/20, of 2.01 Ml/d, as the baseline for this plan. Most of this volume is water taken legally due to standpipe hire, void properties that are actually occupied (assumed to be 20% based on council tax records and other evidence), and meters which have slowed or stopped.

74. This figure is considered to remain constant throughout the planning period, despite an increase in property numbers, due to improvements in data collection and technology.

H. Impact of levels of service on demand

75. We recently updated our drought measures trigger levels and these are presented in our current Drought Plan (2022). These groundwater and reservoir trigger levels were derived from 19,200 years of stochastically generated weather sequences to deliver our declared drought measure levels of service. The method is explained in more detail in our Drought Plan (Drought Plan Appendices A and B).

76. Data regarding water savings achieved by sprinkler and full hosepipe bans are aligned with the savings applied in the latest Drought Plan. This is shown in Table 27.

Table 27 Summary of estimated savings from demand actions (from SES Water Drought Plan 2022)

Action	Annual average saving	Peak period saving	Cumulative annual average saving	Cumulative peak period saving
Customer awareness[20]	n/a	n/a	n/a	n/a
Leakage control	0.2%	0.2%	0.2%	0.2%
Pressure management	0.1%	0.2%	0.3%	0.4%
Operational usage restrictions	0.01%	0.01%	0.31%	0.41%

20 Observed net effect of customer awareness.

Action	Annual average saving	Peak period saving	Cumulative annual average saving	Cumulative peak period saving
Temporary use ban: Phase 1	1.5%	3.5%	1.81%	3.91%
Temporary use ban: Phase 2	1.7%	1.9%	3.51%	5.81%
Non-essential use ban	8.5%	13.5%	12.01%	19.31%
Enhanced demand restrictions (More before 4)	>15%	>20%		

Baseline demand forecast and comparison with WRMP19

77. In comparison to WRMP19, baseline demand at 2024/25 is 6.1Ml/d lower due to the effect of the demand reduction schemes taking place throughout AMP7 including metering and leakage reduction. By 2074/75, the difference has extended to 23.7 Ml/d largely due to lower population forecasts in this plan in comparison to those produced for WRMP19.

78. An overview of our demand forecasts across each component are provided in Tables 28 and 29.

Table 28 Baseline demand forecast (DYAA)

Component	Demand at 2024/25 (Ml/d)	Demand at 2074/75 (Ml/d)
Household demand	110.92	124.51
Non-household demand	25.15	24.48
Leakage	20.48	19.79
Water taken unbilled	2.01	2.01
Distribution system operational use	2.73	2.73
Total	**161.36**	**174.27**

Table 29 Baseline demand forecast (DYCP)

Component	Demand at 2024/25 (Ml/d)	Demand at 2074/75 (Ml/d)
Household demand	150.65	169.04
Non-household demand	25.15	24.91
Leakage	20.48	19.79
Water taken unbilled	2.01	2.01
Distribution system operational use	2.73	2.73
Total	**201.11**	**219.13**

We have assessed how we will scale up our forecast to reflect the level of demand in a dry year, on average across the year and during the peak demand period only. We have selected 2003/04 to be representative of a dry year, with a dry year factor of 1.08 and a critical peak factor of 1.47. We have calculated additional uplift factors for severe and extreme drought scenarios. The impact of restrictions, such as a hosepipe ban, is taken into account based on our latest Drought Plan assessment.

We have forecast the properties in our supply area to reach 408,640 by 2074/75, a 36% increase over the 50-year period. The population is expected to increase by a lower amount, of 17%, to 871,000 over the same time period as forecast under the housing plan scenario due to the expected decrease in occupancy levels. Other forecasts, including ONS trends and housing need give a wide range of forecasts.

Household consumption is forecast using micro-component analysis and metering segmentation. Metering is forecast to slightly increase to 93% by 2030 under baseline conditions. Overall demand increases by 11% over the planning period, despite a decline in per capita consumption of 7.7% in a dry year.

Climate change increases external use by 0.6% on average and 1.6% in peak conditions in comparison to a 1 in 500-year scenario.

Non-household demand, which is mostly from the service sector, is largely stable and is forecast to decline slightly over the planning period.

Baseline leakage is maintained at the 2025/26 target level. Minor components (Water taken unbilled and Distribution System Operational Use) remain unchanged from the WRMP19 assessment. These volumes are forecast to be stable across the planning period.

SECTION 5

Section 5 Our baseline supply demand balance

5. Our supply demand balance

In this chapter we set out our methodology to determine our supply demand balance across the various scenarios our adaptive plan is considering. We describe which scenario is used to represent the regulatory compliant ('reported') scenario. We explain how uncertainty is added by calculating the 'headroom' needed for certain components that are not already included in the adaptive planning model, before presenting the baseline supply demand balance. Finally, we comment on our baseline drought vulnerability assessment and compare our baseline supply demand balance to our current plan from 2019.

A. Baseline supply-demand balance methodology

1. For this plan we have created nine different supply-demand balances (SDB) for each forecast type; Dry Year Annual Average (DYAA) and Dry Year Critical Period (DYCP) under a 1 in 500-year drought frequency – in essence preparing 18 balances.
2. The SDB compares the supply and demand forecasts, including an assessment of uncertainty, to determine whether resources are projected to be in surplus or deficit at any point in the planning period. If the resource zone is in surplus for the entire planning period, no further options are required, although this water is available to be shared with neighbouring regions. In contrast, where demand exceeds supply and therefore there is a deficit, options are needed to address this.

Scenario branches

3. In Chapter 7C we set out in further detail our approach to adaptive planning and that we have opted to create a series of plans as a means to manage future uncertainty in an optimum way. The branch trajectories are based on three factors which could significantly change the direction of our supply demand balances – population growth, environmental destination and climate change. There are other factors which are uncertain and these are captured as part of an headroom assessment, covered later in this Chapter.

Regulatory compliant ('reported') scenario and alternative scenarios

4. The planning guidance requires that one scenario is selected that meets all the relevant criteria to represent the key scenario. Other scenarios can be compared against this to give confidence that the plan is able to provide sufficient supplies in the future should the forecasts move away from this pathway in either direction.
5. The region has selected Situation 4 as the most appropriate scenario to align with the Guideline in representing the regulatory compliant pathway. We provide further explanation across the scenarios in Chapter 7 but, to outline the basis of the reported pathway for our plan and the baseline supply demand balance, we have provided an overview of scenario components below (Table 30), and two possible futures (situations) which can be used for a simplified comparison (Table 31).

Table 30 Overview of scenario components for the reported pathway

Component	Scenario
Environmental destination	'Enhanced' scenario, used as 'high'
Climate change	'High' emissions scenario
Population	Housing plan growth forecast, used as the principal 'central' forecast

Table 31 Description of alternative scenarios used for comparison to the reported pathway

Alternative scenario	Comment
Situation 1	Presents the most challenging scenario in terms of population growth, climate change and environmental destination.
Situation 8	A plausible but less challenging future based on the ONS-18 population growth forecast. This level of growth aligns with the Ofwat common reference scenario 'no/low regrets' baseline scenario.

B. Headroom allowance (Uncertainty)

6. Before calculating the baseline supply demand balance we add an additional amount or 'allowance', known as headroom, to both the demand and supply forecasts. Headroom is defined in the Guideline as a *buffer for uncertainty between supply and demand designed to cater for specified uncertainties*. Its purpose is to allow for variations in the supply and demand forecasts.

7. We have aligned our previous approach to headroom with the transition to an adaptive plan. A summary of our approach and results is given below, with more details of the technical work carried out by Atkins is included in Appendix D.

APPENDIX D Headroom Assessment

8. For this plan, we have adopted a regionally agreed methodology[21] that tailors the industry accepted methodology from UKWIR (including the *Risk Based Planning Methods*, 2016) with the adaptive planning approach. This is to ensure risks are not double counted.

9. With a non-adaptive plan, there is a single forecast of the future where all the uncertainties can be added to create a supply demand balance including a fixed target headroom. However, with an adaptive plan, some of these uncertainties are built in since it is based on a range of potential future forecasts. For the core pathway in the plan, up to 2035, all the components should be included (except S1, 2 & 3), known as the full target headroom. After the branch points, components which relate to the factors used in the adaptive plan, i.e. uncertainty related to population growth, climate change and environmental destination have been removed and the central estimates used. The assessment without the population growth component of demand is known as the Environmental Destination and Growth (EDG) profile, whereas the assessment without the climate impact (S8) is known as EDGS. This combined headroom profile is referred to as the hybrid headroom profile.

21 Target headroom approach for an adaptive plan (WRSE, September 2022)

Supply headroom allowance

10. Nine uncertainty factors are combined to calculate headroom allowance for supply:

S1 Vulnerable surface water licences

S2 Vulnerable groundwater licences

S3 Time limited licences

S4 Bulk imports

S5 Gradual pollution

S6 Accuracy of supply-side data

S8 Impact of climate change on deployable output

S9 New sources

11. Components S1, S2 and S3 are not used as per the Guideline.

12. The underlying headroom data is based on that used in our current plan, WRMP19. A Monte Carlo simulation is used to model the variance probability of each factor using known data and other information. Factor S4 has not been included in the analysis, as we do not have any bulk imports. For gradual pollution (S5), we have assessed confined chalk sources as a separate group to the unconfined group. Based on our current WINEP, the main risks identified are bacteria/parasites (e.g. cryptosporidium), nitrates and pesticides. The accuracy of supply-side data (S6) is now assessed on a 95% probability basis. The method for S8 and S9 is unchanged from the previous assessment.

Demand headroom allowance

13. There are four uncertainty factors relating to demand:

D1 Accuracy of Sub-component Demand Data

D2 Demand Forecast Variation

D3 Impact of Climate Change on Demand

D4 Demand Management Measures

14. As described earlier, some aspects of uncertainty are excluded in the headroom profiles which apply from 2040. This includes most of D2 and D3. All other headroom calculations are taken from the WRMP19 plan.

15. For D1 it was assumed that there was a 95% probability that values are within 3%. This component is stable throughout the period.

16. For D2, whilst the impact of the variation in population growth is excluded, there are other sources of uncertainty in the forecast. This includes the impact of Covid-19 on consumption based on the results of a study by Artesia. More details are available in Appendix D, but in summary non-household demand is reduced by 3.5% and household demand increased by 1.5%, both scaled linearly up to 2040/41 after which no further impact is applied. This date was selected at a regional level as being a reasonable and conservative estimate.

APPENDIX D
Headroom
Assessment

17. Uncertainty on demand management options (D4) cannot be assessed until the final plan has been produced following the options appraisal and selection, and programme appraisal.

Total headroom allowance

18. When the supply and demand headroom allowances are combined, the overall results are as given in Table 32, based on the 1 in 500-year scenario. The level of acceptable risk was determined to be 95% probability at 2025, falling to 85% by 2074/75. A higher level of risk

is more acceptable in the future as there is more time to adapt to any changes in deployable output or demand. The Guideline promotes the use of this 'glide-path' approach.

19. In the first ten years of the plan, before initial the branch point occurs, the full target headroom applies. Between the first and second branch points, the EDG target headroom applies, since the uncertainty relating to population growth is already accounted for in the adaptive plan. In the final stage of the plan, after the second branch point, the EDGS target headroom applies, as the uncertainties relating to climate change and other factors are built into the forecasts in each pathway.

Table 32 Target Headroom based on Uncertainty Analysis at 2069/70

Scenario	Full target headroom	EDG target headroom	EDGS target headroom
DYAA (Ml/d)	11.69	7.35	4.38
DYCP (Ml/d)	15.58	14.47	9.50

20. The full profiles, including the impact of climate change and other components, can be seen in Figures 19 and 20. At the start of the planning period, full target headroom is at 8.43Ml/d (as measured by the target headroom line), decreasing to 4.61 Ml/d by 2069/70 (as measured by the EDGS target headroom line), under annual average conditions. The trends are similar under the critical period scenario but starting at 11.55Ml/d and declining to 5.95Ml/d.

Figure 19 Composition of DYAA target headroom (Ml/d)

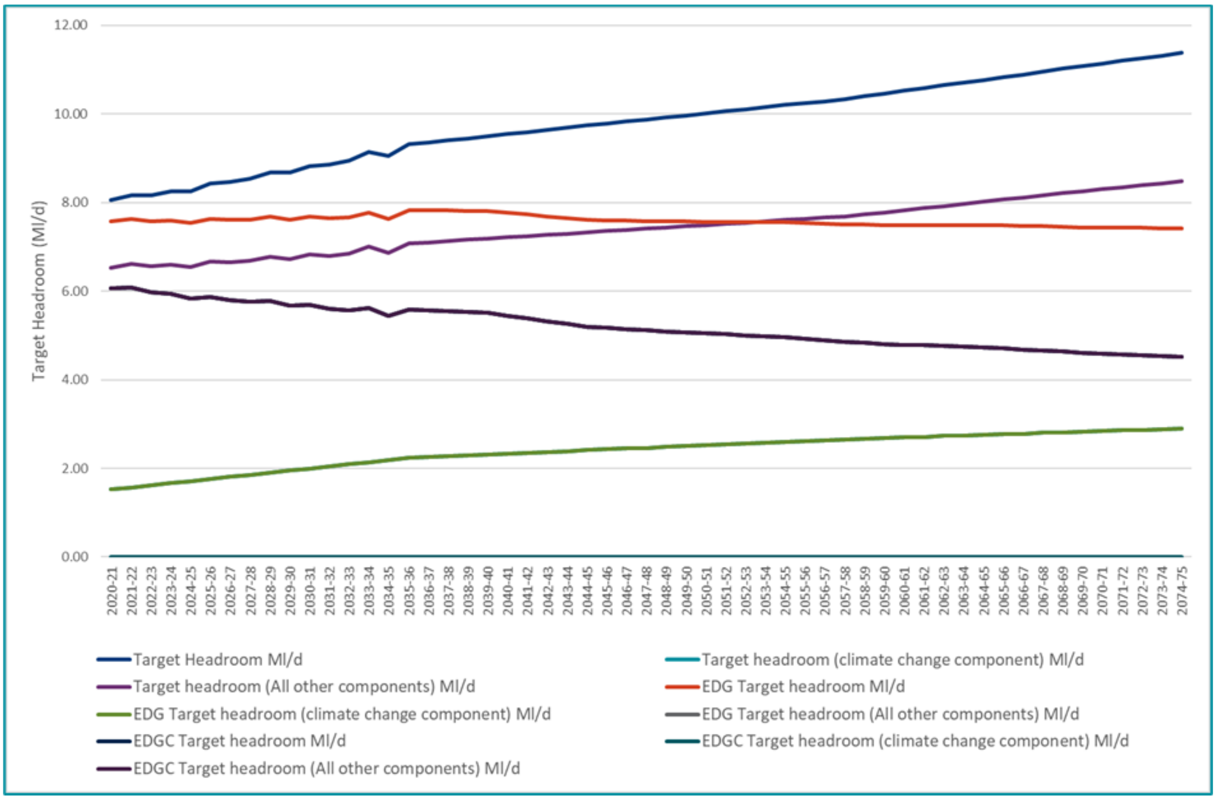
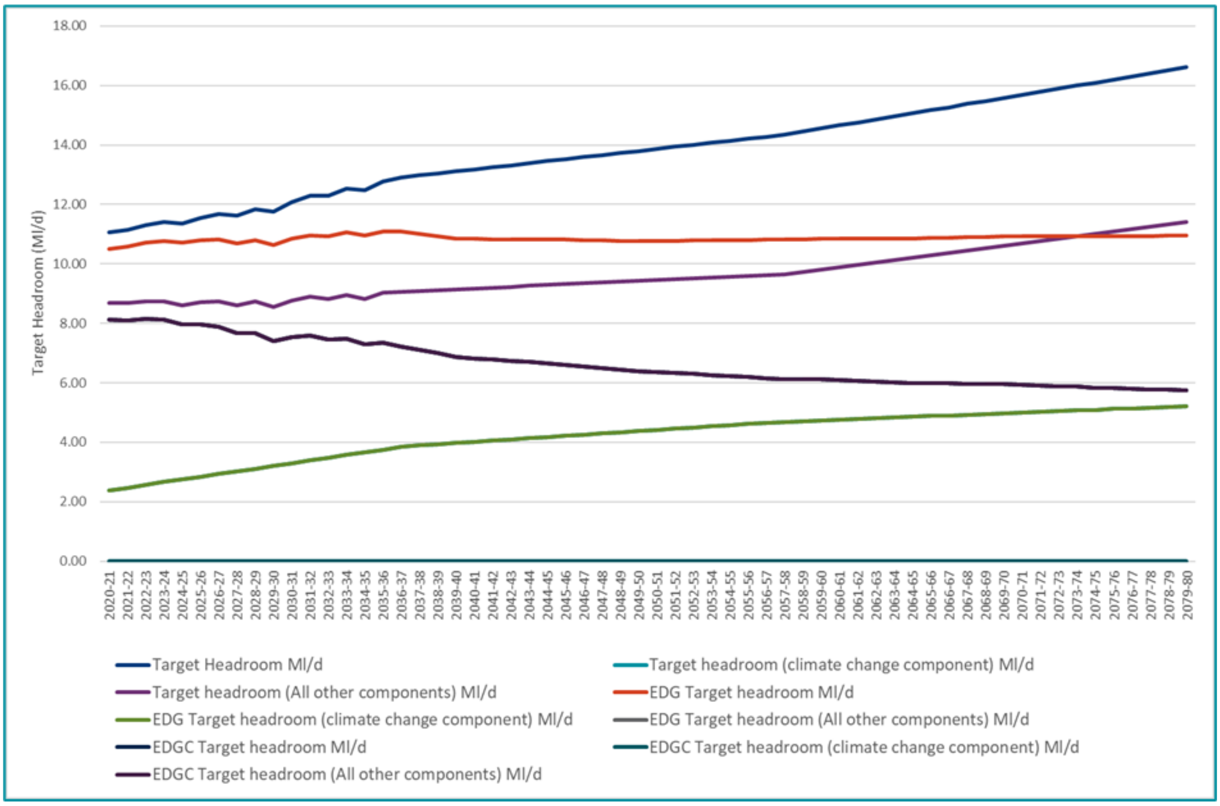


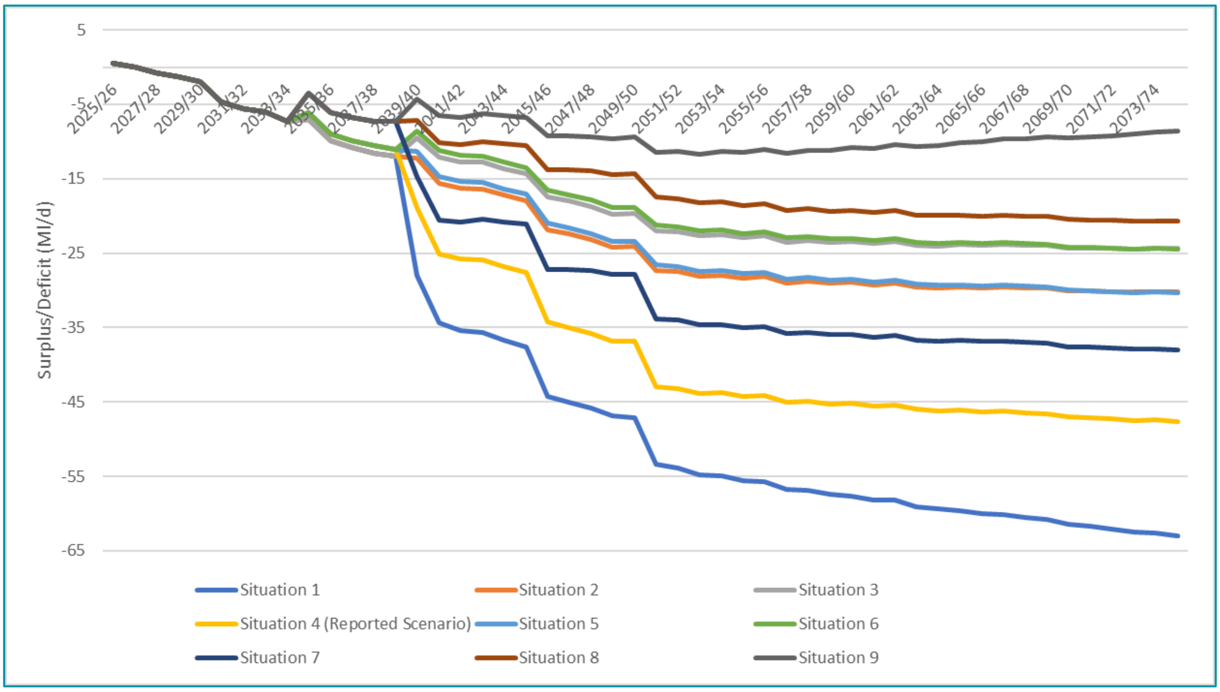
Figure 20 Composition of DYCP target headroom (Ml/d)



C. Baseline supply demand balance results

21. The results of our baseline supply demand balance under the average 1 in 500-year scenario are shown in Figure 21. This shows that, with the inclusion of our headroom allowance, we reach a deficit from 2026/27. By the end of the period (2075), the deficit has increased to between 8.56Ml/d to 62.95Ml/d.

Figure 21 Baseline supply demand balance across all adaptive plan situations (DYAA)



22. Taking our key scenarios for comparison, we have provided an overview of the baseline supply demand balance below (Table 33).

Table 33 Overview of baseline supply demand balance for reported scenario and comparable scenarios (DYAA)

Scenario	Baseline SDB (2025/26)	Baseline SDB (2049/50)	Baseline SDB (2069/70)
Situation 4 (reported pathway)	0.48Ml/d	-36.86Ml/d	-47.59Ml/d
Situation 1	0.48Ml/d	-47.11Ml/d	-62.95Ml/d
Situation 8	0.48Ml/d	-14.30Ml/d	-20.73Ml/d

23. The critical peak scenario baseline supply demand balances are shown in Figure 22. This highlights that there is a deficit of 31.85Ml/d from the start of the planning horizon. The deficit by 2074/75 is calculated to be in the range of 28.2Ml/d to 75.24 Ml/d. A table providing the reported pathway and comparable scenarios is provided at 25year timeslices further below.

Figure 22 Baseline supply demand balance across all adaptive plan situations (DYCP)

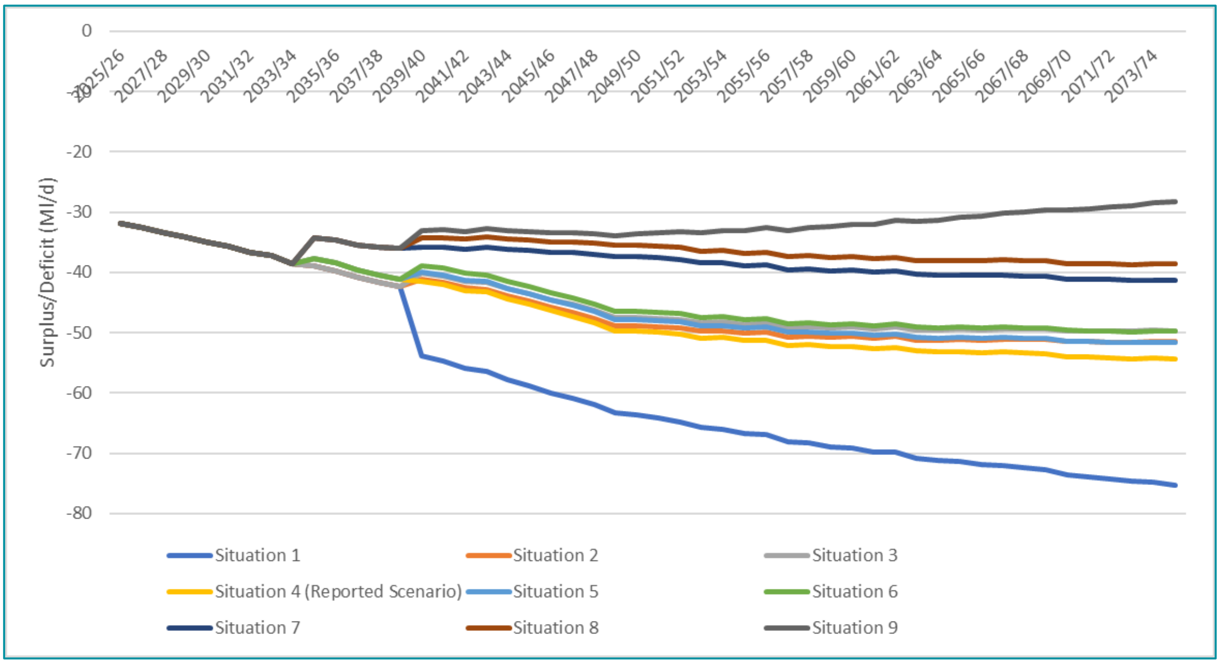


Table 34 Overview of baseline supply demand balance for reported scenario and comparable scenarios (DYCP)

Scenario	Baseline SDB (2025/26)	Baseline SDB (2049/50)	Baseline SDB (2069/70)
Situation 4 (reported pathway)	0.48Ml/d	-36.86Ml/d	-47.59Ml/d
Situation 1	0.48Ml/d	-47.11Ml/d	-62.95Ml/d
Situation 8	0.48Ml/d	-14.30Ml/d	-20.73Ml/d

D. Baseline drought vulnerability assessment

24. As required by the Guideline, we have assessed our vulnerability to different types of droughts. The Guideline suggests using UKWIR's *Drought Vulnerability Framework* or an equivalent approach.

25. As we have calculated our company deployable output for different system failure return periods using 19,200 years' worth of stochastically generated rainfall and evapotranspiration data input to our *Pywr* conjunctive use water resource model, we have used this model to assess our drought vulnerability rather than the Drought Vulnerability Framework. We believe our ability to supply water to our customers (our 'system response') for different levels of service (return periods) is more meaningful than determining deployable outputs for different meteorological return periods. Our baseline supply demand balance is presented in Table 35.

26. It can be seen that for the baseline condition (i.e. without implementing any supply side or demand side measures), we forecast that we are resilient to 1 in 500-year system failure under DYAA demand conditions at the start of our plan in 2025/26, as we forecast a 0.48 Ml/d supply demand balance surplus at this time. However, by 2035/36 we forecast that we have a reduced resilience of between 1 in 100-year and 1 in 200-year system failure.

27. For our baseline DYCP demand condition, we forecast that we are resilient to 1 in 20-year system failure at the start of the planning horizon in 2025/26. This resilience reduces to 1 in 10-year system failure by 2035/36.

28. To increase our resilience to at least 1 in 200-year under both DYAA and DYCP by the start of the planning period in 2025/26 and 1 in 500-year resilience from 2040 to the end of the current planning horizon in 2075, we plan to implement a combination of supply side and demand side measures. Options are considered in Chapter 6 and the supply demand balance and resilience under our preferred plan is presented in Chapter 7.

Table 35: Baseline supply demand balance and drought vulnerability

Demand condition	System failure return period	Supply demand balance (Ml/d) (green/positive values = surplus; amber/negative values = deficit)			
		2025/26	2035/36	2040/41	2074/75
DYAA	1 in 2-year	27.35	17.13	2.57	-21.36
	1 in 5-year	26.69	16.53	2.01	-21.70
	1 in 10-year	25.52	15.43	0.94	-22.54
	1 in 20-year	22.96	12.94	-1.52	-24.78
	1 in 50-year	17.09	7.14	-7.29	-30.32
	1 in 100-year	12.43	2.54	-11.85	-34.66
	1 in 200-year	7.09	-2.60	-16.88	-38.98
	1 in 500-year	0.48	-8.92	-25.09	-47.60
DYCP	1 in 2-year	19.69	11.64	8.91	-7.28
	1 in 5-year	19.28	11.36	8.70	-7.03
	1 in 10-year	18.16	10.38	7.79	-7.49
	1 in 20-year	5.05	-2.60	-5.13	-19.94
	1 in 50-year	-11.67	-19.18	-21.64	-36.00
	1 in 100-year	-20.28	-27.66	-30.05	-43.95
	1 in 200-year	-25.57	-32.61	-34.83	-47.58
	1 in 500-year	-31.85	-38.45	-42.07	-54.39

E. Comparison with our current plan (WRMP19)

29. In our current plan (WRMP19), our baseline supply demand balance calculations for 2025/26 forecast we had a surplus of 14.42 Ml/d under dry year annual average (DYAA) demand scenario and a surplus of 57.25 Ml/d under a dry year critical period (DYCP) demand scenario (both under 1 in 200-year return period deployable outputs).

30. In this plan (WRMP24), our equivalent calculations for 2025/26 forecast a surplus of 0.48 Ml/d under DYAA and a surplus of -31.85 Ml/d (in essence a deficit) under DYCP.

31. The reduction of surplus at DYAA and the change from a substantial surplus to a significant deficit at DYCP between WRMP19 and WRMP24 is mainly due to our calculated baseline deployable output value for WRMP24 reducing significantly from WRMP19. This has arisen from several factors:

- A small part of the reduction is that we are using a more extreme 1 in 500-year drought deployable output value in this plan, rather than the 1 in 200-year condition used for WRMP19.
- A further part of the reduction, particularly under DYCP, is due to the re-analysis of groundwater deployable outputs using updated very long time series stochastic recharge data in our lumped parameter model for the Environment Agency's Chipstead observation borehole. This has recently been assessed as likely to be more representative of natural regional aquifer conditions than the Well House Inn lumped parameter model previously used.
- Additionally, both our groundwater sources and surface water source were, for the first time, combined into a conjunctive water resources model that links into WRSE's regional water resources model. Model runs have revealed that our total company deployable output is less than the sum of the individual source deployable outputs which is how WRMP19 total deployable output was calculated. This suggests that our deployable output is constrained, to an extent, by network constraints.

32. The nature of these possible constraints needs further, more detailed modelling investigation and empirical verification to establish whether they are real and whether they can be removed or reduced – for example, by verifying the modelled reliance of our Horley and Edenbridge demand centres on our Bough Beech source and then investigating how these demand centres could be supplied by sources other than Bough Beech.

33. We propose to undertake such investigations in AMP8 to determine whether there are alternative network options that may be better value than those options currently proposed for implementation later in our planning period.

We have assessed the level of uncertainty of each component of the supply and demand forecast under average and critical period conditions to calculate a headroom allowance. This resulted in a full target headroom allowance of 11.39 Ml/d at the end of the period under average conditions, which would be valid if there was only one situation being modelled. However, since the uncertainties associated with population growth and climate change are already included in the adaptive plan, the revised headroom is 4.52 Ml/d by 2074/75. There is an intermediate headroom allowance profile for the 2030-2050 period of the plan which excludes the population growth uncertainty only.

When the headroom allowances are applied to the supply and demand forecasts we have calculated that there is a deficit in annual average conditions from 2026/27 and a deficit in critical peak conditions from the start of the plan. The shortfall reaches 47.6Ml/d by 2075, or 27.2% of what is needed. This is significantly higher than the deficits produced in the balance from the current plan. This is mainly due to the change in drought resilience from a 1 in 200-year to a 1 in 500-year severity and our reassessment of deployable output using our conjunctive water resources model.

We therefore need to consider a range of options to solve the planning problem and maintain a surplus throughout the planning horizon, whilst providing the additional level of resilience needed.

SECTION 6

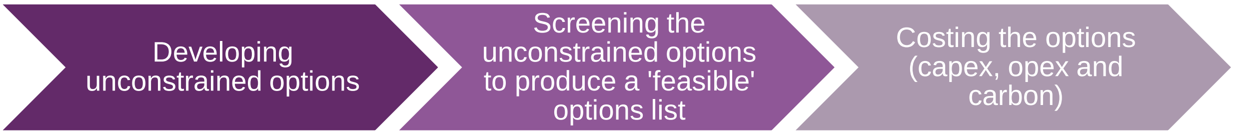
Section 6 Options

6. Options

In this Chapter we define our approach to developing options that could resolve the supply demand balance across the planning horizon. We cover the various factors we have considered when developing options and the methods used to refine them. We summarise our options across the four key areas of new supply options, demand management, green infrastructure and drought option. We comment on some areas of ongoing development before making a comparison of our options list to the current plan (WRMP19).

A. Approach to option identification and screening

1. To ensure consistency across the region, we developed an approach that encompassed three stages.



2. For the first stage, options were developed both from companies individually and together as a region. To ensure fairness, options both inside and outside the region are assessed consistently, objectively and transparently.
3. Our company-derived options were created with support from Atkins to follow an agreed regional process, including re-evaluating previously rejected options using the same criteria. This is detailed in Appendix E. We have carried out a one-step screening process, with unconstrained options filtered down to a feasible list in one stage, although in some cases using initial and secondary screening criteria.

APPENDIX E
Options Appraisal Methodology

4. We reviewed options from both the current plan (WRMP19) and our previous plan (WRMP14). We updated the option yields to align with the reassessment of deployable output (as detailed in Chapter 3).
5. WRSE options were derived by assessing the potential for import and export transfer options to other regions, inter-regional transfer options between companies, catchment management and multi-sector options – better conducted at a regional level[22].
6. The screening process removes options which have an unacceptable environmental impact, a high risk of failure or an insufficient yield or demand reduction. The feasible options are subsequently developed to determine costs and assess environmental and social impacts, so that they can be modelled to produce the required solution to the planning problem.

22 Options Appraisal Method Statement (WRSE)

Factors affecting development of options

7. When developing potential options we considered the following factors.

Factors	Commentary
Government policy	In April 2022 Defra issued the *Government expectations for water resource planning* to water companies, setting out their expectations for companies to: • be pro-active in understanding the short, medium and long-term risks to the environment, and identifying options to manage these • conserve and enhance nature and the water environment, ensuring delivery of biodiversity net gain and using natural capital in your decisions to deliver wider environmental improvement and reduce risks from natural hazards. • should ensure new sources of water are developed in collaboration with other companies and/or third parties where appropriate to benefit both local and regional needs, selecting the best value options • should demonstrate how water companies have, in developing new supply and demand options, engaged with customers and stakeholders to identify opportunities to benefit multiple water users and the environment This approach is supported by other government and regulator policy statements and guidelines, including the National Framework for Water Resources.
Customer preferences	We recognise the importance of establishing customer priorities in terms of both willingness to pay for future investment and how we should plan for the future taking into account social and environmental impacts. As discussed in Chapter 2, we carried out research and consultation on these areas and established what customers care most about and the extent to which they are willing to pay for improvements in service.
Resilience	As we have set out in our plan (Chapter 8), we intend to increase the resilience of the region's water resources to drought so that the need for emergency drought restrictions (such as rota cuts and standpipes) reduces to no more than once every 500 years on average (known as a 1 in 500-year drought risk). The aim is to achieve this level by the end of 2039/40 at the latest. This allows us to create a preferred plan which addresses the need to be resilient to challenging but plausible future droughts. We have also considered whether the options selected contribute to increasing resilience in other ways, such as: • Reducing outage • Reducing flooding risk • Increasing the capacity of water to be transferred around the network, which assists our ability to manage treatment works outage and network events including major burst mains and freeze-thaw events • Developing transfers between third parties or other water companies • Improving raw water quality or reducing the impact of poor water quality • Encouraging consumers to understand the impacts of water use on the local environment to promote water efficiency especially in times of need • Contributing to the resilience of aquatic ecosystems to reduce the impact of drought or other risks such as pollution events
Third party options	Together with the region, we investigated options that could be available from outside the companies to either increase supplies or reduce demand through a Bid Assessment Framework, published in 2020. Those bidders who were solely related to one company's supply area were referred to that company,

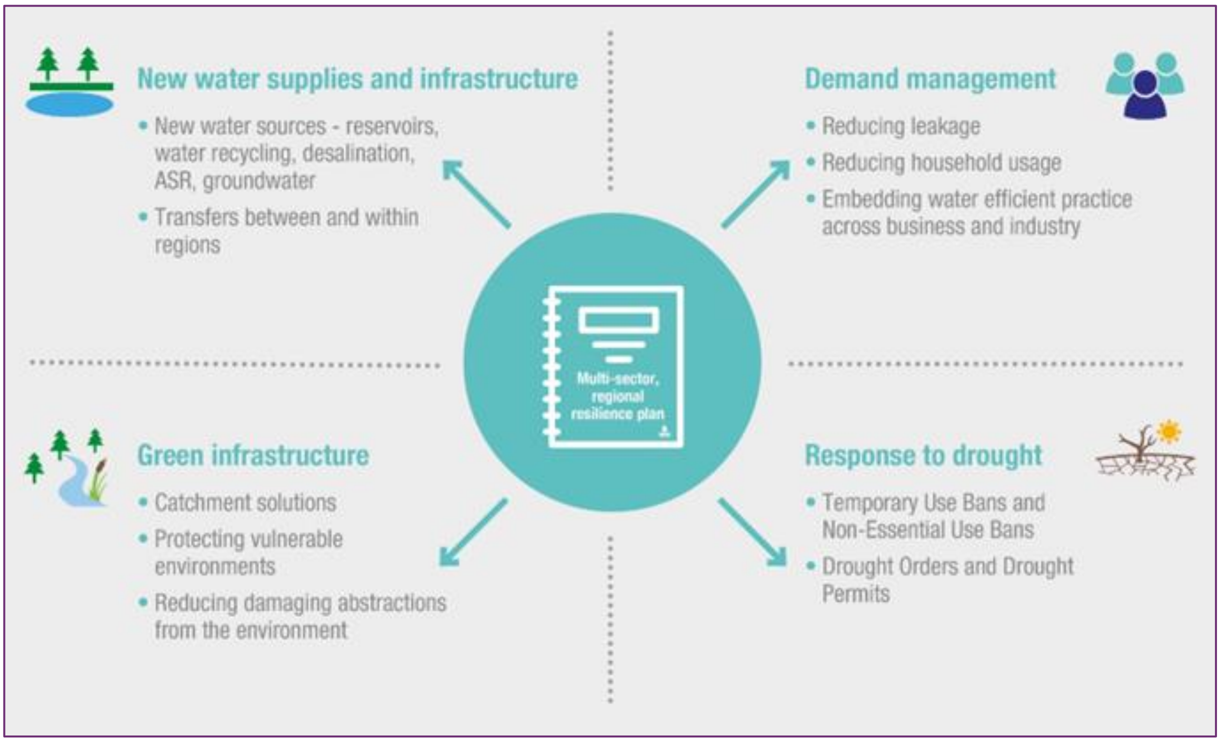
Factors	Commentary
	and we can confirm that no bids have been referred to us. Region-wide options were assessed by the WRSE Project Management Board. We operate our own Bid Assessment Framework[23] where potential suppliers and other third parties can submit a proposal. We did not receive any third-party option bids for this plan but we continue to engage with and seek further third party opportunities across our operation. We believe we are aligned with Ofwat's public value principles in this regard.
Demand management recommendations	In *Meeting our future water needs: a national framework for water resources*[24], government recommendations in relation to household consumption and leakage were set out, as well as an assessment of non-public water supplies. It stated that a per capita consumption (PCC) of 110 litres/person/day by 2050 is the national ambition. As a region, we opted to carry out a regional PCC assessment of the impact of the proposed plan, rather than constrain our regional investment modelling to only provide outcomes where PCC levels achieve the target at a sub-regional or zonal level. Since publishing our draft plan for consultation In 2018, Ofwat commissioned a paper on the *Long Term Potential for Deep Reductions in Household Water Demand*[25]. This concluded potential savings of 50 to 70 litres per person per day could be achieved in the next 50 years. It is acknowledged that these savings can only be achieved if actions outside of the water industry are taken, such as labelling of water-consuming products and linking this to minimum standards in Building Regulations. In 2019, English water companies made a Public Interest Commitment to triple the rate of sector-wide leakage reduction by 2030, and to meet the National Infrastructure Commission's challenge to halve leakage by from 2018 levels by 2050. Water UK has published a routemap to achieving these reductions. In effect, these leakage reductions were built into the regional model so that these are the minimum levels of reductions that must be achieved. Since this Public Interest Commitment, the introduction of the Environmental Improvement Plan in 2023 has placed ambitious targets on water companies to reduce consumption and leakage at interim timestamps, notable March 2027, March 2032 and March 2038. Since publishing our draft we have reviewed options in context of this additional policy.
Environmental enhancement	The Environmental Improvement Plan and Defra's subsequently published Integrated Plan for Water, sets out the government's strategy to achieve a localised (catchment-based), approach to the water system that improves connectivity between water infrastructure (natural and/or built); resource use; environment needs and climate adaptation; social value, biosecurity and pollution risk; and biodiversity. Catchment options were developed, although there have been limitations to assessing their 'value' as not all environmental enhancements provide reduced demand and increased supply benefits. We provide further detail in this Chapter (Chapter 6D).

23 Suppliers to SES Water | SES Water
24 Meeting our future water needs: a national framework for water resources - GOV.UK (www.gov.uk)
25 The long term potential for deep reductions in household water demand - report by Artesia Consulting - Ofwat

8. To initiate the screening process, the unconstrained options are arranged into the following groups (Figure 23) so that they may be assessed appropriately. Appendix E provides further information on the process followed for each option group.

APPENDIX E
Options Appraisal Methodology

Figure 23 Defined option types



B. New water supply and infrastructure options

9. These options were previously termed 'supply-side' options. As we have previously screened a large proportion of our supply needs through options, we did not identify any additional schemes that may be able to provide water supplies for average and/or peak condition that were not previously considered in WRMP14 and WRMP19.

10. Our options were further separated into those relating to:

- abstraction at new or existing sites, and those where new or additional treatment would result in an increase in yield
- treatment options
- pipeline transfer and bulk supplies

11. The options were screened against the following assessment criteria (Table 36) to identify whether any should be rejected for specific reasons.

Table 36 Assessment criteria for option screening

Initial screening criteria	
CAMS status	Catchment Abstraction Management Strategy (CAMS) - The Environment Agency (EA) guidance on water availability within the option catchment, i.e., whether there is a sustainable source of water available for the option.
WFD status	Water Framework Directive (WFD) - Does the option affect the status of any WFD waterbody?
WFD risk of deterioration	Does the option add any risk of deterioration to a WFD waterbody?
Risk to designated sites	Are there any designated sites that could be affected by the option?
Secondary screening criteria	
Customers	Are customers likely to object to the option.
Other abstractors / water companies	Does the option affect other abstractors?
Yield uncertainty	Are there concerns that the option may not provide as much water as hoped for?
Water Quality	Are there any water quality concerns with the source water that are not treated by the option?
Change in DO of scheme	Does the option provide a significant volume of water?
Flexibility	Can the yield of the scheme be increased/decreased if needed?
Technical Difficulty	Are there any significant technical difficulties associated with delivering the option?
Sustainability	Is the option sustainable?
Social Impact (people and places)	Does the option affect people?
Social Impact (flood resilience)	Does the option impact flood resilience?
Social Impact (drought resilience)	Does the option impact drought resilience?
Landscape and Heritage	Does the option impact the natural landscape or heritage sites?

12. To support a consistent approach to environmental screening, Atkins carried out a review of the WRSE methodology across a sample of our options. In general, Atkins considered our process was in alignment with the regional approach.

13. With support from Atkins, we reassessed the option yield over a range of scenarios in average and peak conditions. Capital cost (capex) values were uplifted by a factor of 1.15 across the WRMP14 options and by 1.09 across WRMP19 options to align with base year prices. Operational costs (opex) were also rebased using the same uplifts as capex.

14. Electricity costs were separated as part of the regional modelling requirements, and we followed the regional methodology to calculate carbon emissions – both embodied and operational – with Optimism Bias adjustments. As all of our electricity is sourced from

renewable sources, which is not expected to change in the future, and this is taken into account.

15. A full list of our options is provided in Appendix E, including justification for inclusion or rejection of each one. None of the options are classed as *Strategic Resource Options* which would be submitted separately to resource options in the plan. In summary we collated 60 options in our unconstrained list (although some options are the same proposal at different capacities) and 18 removed after screening.

16. Some of the rejected options only had a deployable output benefit to other companies and these are therefore not included in our register of options but can be considered by the benefitting company. This removes the risk of duplication within the regional investment modelling.

17. A summary of the unconstrained options, and those remaining after screening, is provided in Table 37. Note that there are mutually exclusive options, such as transfers and differing capacity levels, and therefore the totals do not represent the overall amount which could be yielded. We have provided a brief description of the feasible options for ease of reference.

Table 37 Overview of new infrastructure options numbers by type

Option type	Unconstrained options (units)	Feasible options (units)	Feasible options (Ml/d)
Surface water – increase capacity	4	1	12.4
Groundwater – new source	30	8	42.3
Groundwater – treatment	5	4	7.9
Effluent re-use and flood storage	3	0	n/a
Transfers	12	4	60.0
Licence trading	3	0	n/a

Surface water – increase capacity

Reference	Description
R1 Raising Bough Beech Reservoir	A scheme option to raise the reservoir embankment to facilitate additional storage, providing 11.5Ml/d benefit (ADO). This option would not change the existing abstraction licence conditions. A lead in time of ten years is required, before the option could be utilised.

Groundwater – new source

Reference	Description
R2 North Downs Confined Chalk (Extension 1, Bishopsford Road)	A scheme option to connect an existing borehole (drilled 2008) to our Cheam WTW, providing 5.0Ml/d benefit in peak *only* to recover artificially recharged volumes – an option of our Hackbridge licence. A lead in time of three years is required.
R3 North Downs Unconfined Chalk (Recharge at Eyhurst Park)	A scheme option seeking to abstract groundwater from Leatherhead during groundwater highs and artificially recharge down into the unconfined chalk – supporting summer groundwater levels further north (i.e. Chipstead, Holly Lane, Woodmansterne, Smitham and Purley). It is expected that the recharge of the aquifer and resulting

Reference	Description
	increase in peak period deployable output would be approximately 5.0Ml/d. A lead in time of 12 years would be required.
R4 North Downs Lower Green Sand (Recharge at Eyhurst Park)	Similar to above, albeit this scheme option seeks to recharge the Lower Greensand – supporting summer groundwater levels. It is expected this recharge and resulting peak deployable output would be approximately 2.5Ml/d. A lead in time of 12 years would be required.
R5 New borehole at Fetcham Springs	A scheme option seeking to utilise water availability in the Lower Mole, as indicated by the Catchment Abstraction Management Strategy (CAMS), and identify a new source location for groundwater abstraction. A pipeline would be required to our Elmer WTW, where there is existing capacity. This option would provide 17Ml/d (ADO) and require three years lead in time before utililsation.
R6 New borehole at Chalk Pit Lane	A scheme option to connect and commission our Chalk Pit Lane borehole, already licenced at 3.5 Ml/d. Further optioneering would be required to ensure sufficient capacity at the WTW options and any necessary enhancements that may be required as a result. Deployable output benefit is therefore limited to WTW capacity, at 1.22Ml/d.
R21 North Downs Confined Chalk (Extension 2)	The scheme option includes drilling a new borehole approximately halfway between two existing sources, providing additional deployable output in peak only.
R22 Outwood Lane	This scheme options seeks to increase the daily licence of an existing source from 3.02Ml/d to 8Ml/d, with the equivalent increase in pump capacity required. The increase in deployable output from the scheme is approximately 2.66Ml/d and this option would require a one year lead in.
R23 Duckpit Wood	A scheme option to construct a new borehole to replace the Duckpit Wood and Paines Hill spring licences, providing an additional 1.37Ml/s (ADO). Additional scheme optioneering would be required and a lead in time of eight years has been outlined.

Groundwater – treatment

Reference	Description
R7 Water Lane	Option to increase pump capacity and treat pesticides, thereby removing a water quality constraint. This would provide 2.2Ml/d (ADO) and required three years lead in time.
R8 The Clears	Option for ammonia and pesticide treatment for our Clifton's Lane licence group – currently constrained by the deepest available pumping water level (DAPWL) and water quality at one source. This option would provide 0.45Ml/d (ADO) and required three years lead in.
R24 Duckpit Wood	Scheme option aiming to provide hydrogen sulphide treatment to bring this source into supply (and is therefore mutually exclusive to R23, above). This option would provide 0.77Ml/d (PDO only) and require three years lead in time.
R26 Secombe Centre	This scheme option provides UV treatment for the Secombe Centre groundwater source, currently out of supply due to bacti detections on the raw water. Due to the limited footprint available at the Secombe Centre site, the UV treatment plant would be located at Cheam WTW. This option would provide 2.07Ml/d (ADO) and require three years lead in time.

Transfers

Reference	Description
R9, R10, R11 Bulk supply from Thames Water	Options for a transfer at an existing site in Merton, with capacity options between 5Ml/d to 30Ml/d. These would require different network enhancements to support transfer levels.
R14, R15 Bulk supply from South East Water	Options for a transfer at Maidenbower/Whiteley Hill, with capacity options at 5Ml/d or 10Ml/d (not mutually exclusive). This would require a new treated water transfer and softening plant at Outwood prior to distribution into our network.
Bulk supply from Southern Water	A reverse of a possible transfer option between us and Southern Water, with a capacity of 10Ml/d.
Bulk supply from Thames Water	Option for a regional modelling transfer solution 'Guildford to Reigate', with a capacity of 10Ml/d.

C. Demand management options

18. We review options to reduce demand across three particular categories:
    - Leakage reduction (distribution network and customer supply pipes)
    - Water efficiency (behaviour change and physical interventions at household and non-household level)
    - Metering (conversion from fixed rate to metered tariff, smart metering)
19. To ensure alignment across the regional water companies, a methodology was adopted to initially group the categorised options into three 'strategies' or 'baskets' – **high**, **medium** and **low**. This was based on a reduction above, equal to and below the level planned for our previous plan, WRMP19.
20. The strategies were built up from average savings and costs across the categories – leakage, water efficiency and metering – and enabled efficient processing from the regional investment model. Guidance was also developed to consider the impact of government interventions to reduce demand, such as water use labelling of white goods[26].
21. We subsequently developed our demand management strategies further, to create a full suite of options required to meet the demand reduction level required using the latest information on savings per intervention, costs and alignment with company priorities. We commissioned the consultancy Artesia to carry out this work, so that our estimates could be compared with the results from other companies to provide reassurance that the assessment was robust and balanced.
22. Since publishing our draft plan for consultation, the Environmental Improvement Plan (EIP) was published and provided interim targets on each company. From the 2019/20 baseline, the targets placed on us by the EIP are as follows.

26 Options Appraisal Method Statement (WRSE)

Table 38 Overview of the EIP interim targets and our associated target outturns

Component		2019/20 baseline	Mar 2027	Mar 2032	Mar 2038	Mar 2050
Leakage[27] Ml/d (2dp)	EIP interim target	-	20%	30%	-	-
	SES Water outturn target	24.84	19.90	16.60	-	-
Per capita consumption (PCC) l/h/d (1dp)	EIP interim target	-	9%	14%	20%	[Reach 110]
	SES Water outturn target	149.0	135.6	128.1	119.2	110.0
Non household demand Ml/d (2dp)	EIP interim target	-	-	-	9%	15%
	SES Water outturn target	26.17	-	-	23.44	22.24

23. Consultation responses to the draft plan outlined broad support for our approach to ambitious demand management targets, although the original targets do not fully align with the subsequently published EIP interim targets (as set out above). Challenges made by our regulators referenced the costs relating to our leakage reduction proposals which we consider is a direct consequence of being in the upper quartile of performance and operating beyond the economic level of leakage.

24. Nonetheless, the clear expectations from the EIP and our consultation responses provided an opportunity for us to review and refine our demand management strategies. We therefore updated our demand management strategies based on further modelling work with Artesia and a detailed assessment of the savings from consumption reduction measures we currently undertake (such as home and non-household visits). We have detailed components included in our plan below.

Smart metering

25. Our draft plan included a selected option for smart metering to be rolled out across our measured household properties. This aimed to provide 3.63Ml/d in consumption savings across the planning horizon.

26. We revised our assessment of consumption savings on the basis of findings across the industry and with the input of consultants. Our plan tables therefore set out consumption savings of 5.11Ml/d across the planning horizon, with this attributed over the course of our proposed seven year roll out.

27. Based on consultation responses we were also challenged on our non-household smart metering rollout. On reflection we consider there should be a uniform rollout across household and non-household properties. We have therefore set out expected savings of 1.14Ml/d over a seven-year rollout of smart metering across non-household properties.

28. In addition to a reduction in consumption, we believe smart metering will be key to supporting our next phase of leakage reduction. The identification of customer-side leakage (CSL), as part of a renewed CSL strategy, will provide additional benefit of 1.1Ml/d over the rollout programme of smart metering. This strategy will in effect delay our aspects

27 Based on Ofwat consistent methodology.

of our asset renewal (mains replacement) plan, which is relatively more expensive when comparing cost per Ml/d saved, until 2030.

Innovative tariffs

29. We have refined our innovative tariff option on the basis of following the rollout of smart metering, so that we can ensure a fair approach across our customers. We intend to develop our tariff proposals during the next business plan, and our refined profile of consumption reductions in this plan is based on work completed by our consultant and an expected rollout of tariffs across our customers.

30. The rdWRMP24 sets out 1.0Ml/d saving from household tariffs, and 0.16Ml/d from non-household customers.

Household interventions

31. We operate several initiatives to assist households with reducing their consumption. These take the form of:

- self-service tools such as the Get Water Fit platform, enabling customers to review their water use and order equipment for free to install in their home, and
- household visits – offered through data-led target areas, community visits to vulnerable customers, customers on financial tariffs and wider collaboration opportunities (such as with Councils and Local Housing Authorities).

32. We anticipate delivering continued household interventions and have forecast savings within our plan of 1.87Ml/d[28] during each year of AMP8. From 2030 onwards we have profiled for slightly reduced numbers, and therefore savings, owing to:

- our customers having improved visibility of their usage and our tailored messaging via customer interfaces, and
- our own improvements as a result of interpreting customer use data to better target home visits.

Education programme

33. We currently host education programmes through our Bough Beech Flow Zone centre and school visits/outreach. We have included within our plan the continued delivery of education on-site and in schools. We are also developing opportunities to further this as part of our estate planning.

34. This option provides for relatively smaller savings, calculated at 0.045Ml/d across the planning horizon, but we believe an education programme is a key activity to improving knowledge around the value of water and supports our continued social responsibility to customers.

Government interventions

35. To achieve the new EIP interim targets, the regional companies are increasingly reliant on government commitments to deliver policies to help reduce household per capita consumption (PCC). A timetable of proposed government-led demand management interventions has not been announced and, in light of this uncertainty, WRSE has considered a range of different scenarios that may be implemented at different times. The Government interventions are:

- Low – water labelling across all water using products by 2024 (already committed to by Government). Total savings of 6 l/p/d.

28 Across our Get Water Fit and household visits

- Medium – water labelling plus minimum standards for all water using products. Total savings of 12 l/p/d.
- High – full government support – water labelling, minimum standards and new building regulations for new homes and retrofits. Total savings of 24 l/p/d.

Non-household interventions

36. We have operated a successful programme of non-household activities so far in AMP7 and we are currently progressing further projects within the non-household portfolio. This largely includes water efficiency visits to businesses – targeting specific sectors to enable a coordinated approach across relevant stakeholders and retailers. Coordination with retailers is important and we believe we can link more with retailers throughout the remainder of this AMP and into AMP8 as part of our non-household interventions work.
37. We have refined our assessment of savings attributed to non-household interventions based on our evidence collated during AMP7, increasing our Ml/d saving from 0.16 to 0.38Ml/d.
38. In addition, we are in the early stages of initiating a 'knowledge exchange' with Gatwick Airport – our largest non-household customer. We aim to support Gatwick through their ongoing *decade of change* to exchange best practice and technology implementation across the following components:
    - our smart network and related improvements (where possible) to their on-site leak detection, repair times, and pressure management,
    - water efficiency and rainwater harvesting infrastructure to support non-potable water use,
    - catchment and water system management across their runway runoff water treatment system.
39. We have attributed a demand saving to this opportunity based on Gatwick's strategic targets, however, this is relatively conservative on the basis our contribution is through personnel and we cannot guarantee Gatwick's future investment planning in demand management.

Active leakage control (ALC)

40. In AMP7 we have successfully implemented key initiatives that have helped drive down leakage through enhanced ALC activity. Our **smart network** is helping us to reduce the awareness time of leaks and therefore the overall runtime of large leakage events – delivering an estimated saving to date of 0.3 Ml/d. In addition, we have utilised satellite leakage detection technology to find and localise leakage in our network with an estimated saving to date of 0.6 Ml/d. Further ALC driven leakage reductions, including more efficient location and repair activities, have delivered combined savings up to 1.0Ml/d leakage savings in AMP7 to date.
41. We plan to continue to leverage the benefits of our smart network and have plans to enhance its capabilities in AMP8. Our focus will be on a second phase of smart solution roll out – targeted specifically at reducing the location time of leaks. Using the latest sensors, AI and real time network modelling techniques we plan to cut leak runtimes through faster pinpointing of leakage outbreak in our DMAs.
42. We will continue to challenge ourselves to reduce leak runtime though faster more efficient leak repairs and commit to trialling and help develop new technologies for faster and less disruptive repair techniques.
43. Overall, we plan to achieve leakage savings of up to 1.0Ml/d from ALC activities in AMP8.

Pressure management

44. In AMP7 we have had good success in achieving sustained leakage and demand reductions through targeted pressure optimisation. We have achieved up to 10% savings in customer demand and up to 20% leakage savings in some DMAs. Our **DMA Asset Health** programme has seen us systematically appraise over half of our supply network, carrying out a holistic health check to understand the condition of our assets, their operating conditions and where we can take actions to optimise and prolong asset life – reducing failures and leakage. Through implementation of these schemes, we have calculated a 0.9Ml/d leakage saving with an anticipated further 1.0Ml/d saving still be realised in AMP7. This is forming a considerable part of our leakage reduction programme.

45. Our plan sees us continuing to achieve considerable sustainable leakage and demand reduction benefits from pressure optimisation. In AMP8 we will complete our DMA Asset Health programme and will have holistically appraised the entirety of our supply network. Our pressure optimisation programme will focus on implementing the schemes that this programme recommends. It will involve the installation of new pressure management schemes as well-advanced optimisation of existing schemes. Overall, it will contribute savings of up to 2.0Ml/d in AMP8.

Asset renewal

46. We have fundamentally changed the way that we target our water mains assets for renewal in AMP7. Our DMA Asset Health programme, with its holistic approach to understanding asset condition and performance, has enabled us to switch to a proactive rather than reactive way of targeting water mains assets for renewal. In doing so we now only target assets that are at the end of their life and that have no other options available in terms of extending their usable life (for example though pressure reduction). Whilst it is difficult to quantify the absolute leakage saving so early on in this new approach, we are confident that this approach will help us to better manage our asset base and crucially will form the foundation for an asset renewal-based leakage reduction programme in future AMPs

47. In our plan we have set out our strategy to complete the first phase of our DMA Asset Health work in AMP8. We will then enter into a second phase of works which will see us retest a portion of our network for condition. Crucially this will enable us to develop deterioration curves based on two measured condition readings from our assets. This level of data and understanding currently does not exist in the industry in the UK and worldwide and we plan to use our unique and insightful data to build the next generation of deterioration models aimed specifically but not exclusively at proactively at targeting mains for renewal before they leak or reach a level of leakage that's not sustainable.

48. This important part of our leakage reduction strategy starts delivering leakage savings from AMP9 at a rate of 1.0 Ml/d per AMP and is crucial to our ambitions to reduce leakage by 63% by 2050.

49. A summary of the savings from across these options are provided in Table 39. We have provided costs at appropriate time steps for each strategy, such as smart metering across the rollout programme, and household water efficiency interventions as AMP totals. Detailed costs are included in our data tables.

50. Note that due to population and business growth the total demand reduction could be offset by an increase in demand from these new residents and properties.

Costs associated with leakage reduction

51. Following our Statement of Response, Defra requested further information relating to our leakage costs for reference to Ofwat's requirements. We provided additional information in response and have been directed to provide this as part of our plan. In this sub-section we have set out the details of leakage reduction unit costs to comply with this direction.

52. Table B1[29] below outlines the total anticipated cost of leakage in the next business plan period (AMP8/PR24, 2025-30) which we have entered in our business plan submission to Ofwat. This total cost includes the costs to maintain leakage levels and the costs to reduce leakage levels, so that we are consistent with Ofwat's business plan guidance. If we consider both elements of cost when calculating leakage reduction, we derive the unit cost figure of £11.7m/Ml/d.

Table B 1 Total leakage costs captured in our business plan (PR24 proposals)

Leakage activity	AMP8 total cost (£m), PR24 CW19	AMP8 benefit (Ml/d)	Unit cost £/Ml/d, PR24
Active leakage control (ALC)	24.4	0.5	49.8
DMA asset health (DMAAH)	6.3	0.0	6.3
Smart network	1.7	0.5	3.4
Network optimisation & pressure management	2.1	2.0	1.1
Total	**34.5**	**3.0**	**11.7**

Source: SES Water, extracted from response to Defra's request for further information (29 March 2024)

53. However, the true cost per Ml/d is based on the cost to reduce leakage. Table B2 therefore sets out this element in particular and demonstrates that we are within a reasonable tolerance of the Ofwat quoted industry median of £3m/Ml/d.

Table B 2 Costs of reducing leakage in AMP8 as captured in our business plan (PR24) proposals

Leakage activity	AMP8 total cost (£m), PR24 CW19	AMP8 benefit (Ml/d)	Unit cost £/Ml/d, PR24
Active leakage control (ALC)	1.0	0.5	2.0
DMA asset health	6.3	0.0	6.3
Smart network	1.1	0.5	2.2
Network optimisation & pressure management	2.1	2.0	1.1
Total	**10.5**	**3.0**	**3.5**

Source: SES Water, extracted from response to Defra's request for further information (29 March 2024)

54. This table is included in our response to Ofwat's draft determination and shows that three of the four elements it comprises will deliver leakage reduction benefits within AMP8 – a total of 3.0Ml/d at a total cost of £4.2 million. The fourth, DMAAH at a cost of £6.3m, delivers leakage reduction benefits in AMP9 via the implementation of the network optimisation, mains replacement and pressure management schemes it informs.

29 Alternative table references used in this subsection to acknowledge tables were prepared for separate regulator correspondence and avoid confusion with WRMP document/appendix cross references.

55. Removing our DMAAH costs, as they do not provide leakage reduction benefits in AMP8, reduces leakage reduction expenditure in the AMP from £10.5 million to £4.2 million, and our unit costs of interventions delivering leakage benefits within the AMP to £1.4m/Ml/d. This unit rate is well within the level that could be assessed as efficient from an industry standpoint, particularly when you consider that we are already operating well below the sustainable economic level of leakage (SELL)

56. As leakage reduction increases, an extra pound spent on leakage reduction will tend to lead to a lower reduction in leakage (i.e. there are decreasing returns to scale). As we have been operating well below the SELL, further leakage reduction will require us to incur higher per unit costs of improvement.

57. We point to our strong performance in leakage in AMP7 as both evidence that our strategy is working but also is acting to limit our opportunities to drive leakage reduction through traditional means alone in future AMPs. Put simply, we have already exhausted many of the less expensive leakage reduction interventions.

58. Repeating this approach to calculate AMP9's anticipated leakage activities derives a unit cost of reducing leakage in the five-year period of £23m/Ml/d, as summarised in Table B3

Table B 3 Costs of reducing leakage in AMP9 as captured in our business plan (PR24) proposals.

Leakage activity	AMP9 total cost (£m), PR24 CW19	AMP9 benefit (Ml/d)	Unit cost £/Ml/d, PR24
Active leakage control (ALC)	1.7	0.5	3.4
Asset Renewal, network optimisation & pressure management	60	1.5	40
DMA asset health	1.8	0.0	1.8
Smart network	1.4	0.5	2.8
Total	**64.9**	**2.5**	**26.0**

Source: SES Water, extracted from response to Defra's request for further information (29 March 2024)

59. We recognise the considerable increase in anticipated unit costs from AMP8 to AMP9. This is owing to asset renewal replacing pressure management as one of our interventions, with the latter expected to be an exhausted option by 2030. It is acknowledged across the industry that asset renewal is a relatively expensive option to reduce leakage, due to the cost benefit ratio, but which we will need to initiate to progress our ambition of reducing leakage by 38% by 2035

60. We consider we have a distinct advantage over others when delivering our asset renewal plan because our DMA Asset Health programme has yielded real examples of where strategically targeted water mains renewal can reduce leakage. Our current data outlines that on average, a 1 km of mains renewal will yield a 0.01 Ml/d leakage saving. Therefore, to achieve our target 1.00Ml/d reduction in AMP9 we need to renew 100km of pipe in the five-year period. Based on framework contractor rates we have calculated that we will need £60m of investment in AMP9 for leakage reduction through mains renewal

61. We realise that this is a large cost and indeed comparatively expensive compared to other leakage intervention types. However, with our ambitious plans to continue to reduce leakage we currently have no choice but to make this proposal given where we are on our leakage reduction journey and with the current technologies available.

62. By deferring asset renewal for leakage reduction to AMP9 we will use AMP8 to gain better understanding of the benefits to leakage from smart metering, and we will also have completed our DMA Asset Health programme. We also have faith that the industry will have developed innovations capable of reducing the cost of water mains renewal. With these considerations in mind, we plan to do a full review of unit costs and intervention strategy ahead of the next price review (PR29) and WRMP.

63. We provide the following more general comments to give confidence in our calculation of unit costs and why we believe our cost to reduce leakage is both realistic and ambitious in the context of leakage reduction in the sector:

- Having successfully reduced leakage in line with targets in AMP7 we have a well-founded understanding of the cost to deliver the different intervention types.
- Our unit cost estimates are made on sound evidence base using AMP7 costs (2021/22 baseline) and we have used independent specialist consultants to work with us to derive our projected future costs.
- The industry median of £3m/Ml/d is likely to be skewed towards the lower end of the cost spectrum. This is because many water companies are operating at a different place on their leakage cost curve to where we operate. These companies will have cheaper intervention options available to them. For example, companies who still have widescale pressure management possibilities available beyond AMP8 will naturally have lower unit costs.
- Our ALC costs for the benefits gained are in line with the industry average. The higher figure in AMP8 is being driven by our proposed investment in our smart network, building on our successes in AMP7 and investing for the future.

Further demand management options

64. Rainwater harvesting was also considered by our consultants, although this was not fed into our demand management strategies or the regional planning. Although we encourage local rainwater harvesting, and offer support as part of our suite of water efficiency work, we believe there is a greater opportunity for this function. We are progressing initial work to explore funding options that could support the development of rainwater and grey water harvesting solutions.

65. We consider wastewater providers would have an interest in a rainwater harvesting option, owing to the localised water storage harvesting can provide during a heavy rainfall event. Following the recent publishing of wastewater providers' Drainage and Wastewater Management Plans, we intend to review these and engage with the providers operating across the area, to understand where there may be partnership opportunities to innovate/implement solutions for our customers.

66. Our draft plan received challenge concerning new developments and our role to encourage water efficient homebuilding. We recognise local authorities are denoting that new developments should be built to 110l/h/d within their Local Plans. We have developed an environmental incentive scheme for new developer connections., which will be maintained following Ofwat's removal of the income offset network infrastructure charge.

67. Our environmental incentive requires developers to submit details of the fixtures and fittings due to be installed in new homes so that a discount may be applied on a per plot basis (based on the anticipated household consumption). An inspection is undertaken as part of the Water Regulations to ensure the fittings have been installed. This incentive scheme will be refined over the remaining period of AMP7, in preparation for the income offset scheme being removed by 2025. Where appropriate we will interpret this incentive scheme and the associated expectations of demand into our future water resource planning.

Table 39 Overview of savings and costs from demand management profiles

Option	Low		Medium		High		High+	
	2030	2050	2030	2050	2030	2050	2030	2050
Smart metering (Ml/d)	1.51	3.56	2.28	5.59	2.51	3.56	3.91	5.59
Business smart metering (Ml/d)	0.19	0.46	0.4	1.14	0.32	0.46	0.81	1.14
Smart metering (Ml/d) (leakage reduction[30])	0.20	0.64	0.50	1.10	0.50	0.90	0.50	1.10
Total smart metering cost	£33.23m over 12 years		£38.22m over 12 years		£30.18m over seven years		£36.93m over seven years	
Tariffs (Ml/d)	0	0.52	0	1.00	0	0.52	0	1.00
Business tariffs (Ml/d)	0	0.06	0	0.16	0	0.06	0	0.16
Tariff cost	£0.34m over initial five years		£0.34m over initial five years		£0.34m over initial five years		£0.34m over initial five years	
Household interventions (Ml/d)	1.75	6.34	1.77	6.41	1.85	7.76	1.87	7.79
AMP8 costs	£1.81m		£1.83m		£1.95m		£1.97m	
Non-household interventions (Ml/d)	0.83	3.68	0.85	2.55	1.31	5.80	1.00	2.51
AMP8 costs	£0.38m		£0.38m		£0.57m		£0.46m	
Education programme (Ml/d)	0.03	0.18	0.04	0.20	0.04	0.22	0.04	0.22
AMP8 costs	£0.15m		£0.15m		£0.18m		£0.18m	
Active leakage control (Ml/d)	0.5	1.9	1.0	3.2	1.0	4.15	1.0	4.15
AMP8 costs	£22.2m		£22.8m		£22.4m		£22.4m	
Pressure management (Ml/d)	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0
AMP8 costs	£0.99m		£2.0m		£2.0m		£2.0m	
Asset renewal	-	1.35	-	2.00	-	2.00	-	2.00
AMP9 costs	£40.8m		£60.0m		£60.0m		£60.0m	

30 Not including plumbing losses which is considered as part of consumption reduction assessment.

D. Green infrastructure options

68. For this plan, we considered a new category of options, together as a regional group, involving the use of catchment management or nature-based solutions to increase the amount of deployable output. This could include improvements in raw water quality that enables a disused source to be brought back into use or preventing a deterioration which would otherwise reduce the yield of the source in future.

69. The investment model has been developed to select options based on deployable output needs to manage the supply demand balance across all regional water resource zones. After consideration of the raw water quality risks to our sources, through an assessment of our Drinking Water Safety Plans, we were not able to identify any options which would lead to a deployable output benefit. Most of the substances which may cause a deterioration are not a current challenge to treatment or they are no longer in use (such as metaldehyde, a pesticide used to control slugs and snails).

70. As such, catchment solutions were included as options in our plan but rejected on the basis they do not contribute to the supply demand balance whilst a cost remains against the option. However, we consider that catchment and nature-based solutions are particularly important and are planning to design and progress several schemes over AMP8, AMP9 and beyond. We have developed our plan to explain our ongoing work and approach in better detail.

71. Separately, we consider these form an important element of work during the next planning phase, together with WRSE and the regional companies, to better 'value' catchment and nature-based solutions so that these options may form part of our WRMP in the future. Included within Chapter 3D we have set out our plans to undertake a catchment scale investigation with a view to subsequently delivering a set of nature-based interventions that 'slow the flow' of the River Eden. We are developing similar proposals for the Mole catchment as part of ongoing business planning process. We believe that with further work and research, we will be able to better quantify the benefits of nature-based solutions across various factors (which could include source yield/quality and deployable output; site/asset resilience; social value and biodiversity enhancement).

72. In addition to our own work, we are contributing to a national project led by United Utilities and the Rivers Trust which has successfully sought funding from the **Ofwat Innovation Fund** to develop a value framework for nature-based solutions. We intend to develop our green infrastructure options so that additional options, or iterations, may form part of the screening for future plans and selection.

E. Drought options

73. There are two categories of drought options that have been considered in our plan, as follows:

Table 40 Drought option categories

Category	Description
Usage restrictions	The deployment of temporary use bans (TUBs) which apply to households and non-essential use bans (NEUBs) which apply to non-household properties – restricting the permitted use of water to reduce demand.
Drought permits	The use of permits to increase the amount of water abstracted outside of 'usual' abstraction licence limits – increasing the supply of water.

74. In both categories we can only put these options in place under **drought conditions** and with the appropriate authorisations. Therefore, these options would only be brought into use after all other measures to increase supplies or reduce demand have been taken. More details of the drought options we have assessed is given in Appendix E with a summary below.

APPENDIX E
Options Appraisal Methodology

75. As a region, we developed a methodology using guidance from the Environment Agency on which drought permits could be used in the plan, to avoid the use of permits which would unnecessarily harm the environment.

76. A summary of our drought options and the outcome of the environmental assessment is shown in Table 41. All these options are defined in our Drought Plan. The deployable output benefit of usage restrictions is given as a percentage as the absolute amount will depend on the demand forecast level in that year.

Table 41 Drought options

Option	ADO benefit* (Ml/d)	PDO benefit* (Ml/d)	Environment impact	Confidence rating
River Eden Drought Permit (May)	0.3	0.3	Minor (-ve)	High
River Eden Drought Permit (Summer)	1.4	1.4	Minor (-ve)	High
Outwood Lane Drought Permit	1.98	1.98	Minor (-ve)	Low
Hackbridge Drought Permit	4.00	4.00	Minor (-ve)	Low
Kenley and Purley Drought Permit	2.10	2.10	Minor (-ve)	Low
TUBs	- 3.2%	-5.4%	Positive impacts	-
NEUBs	-8.5%	-13.5%	Positive impacts	-

*in a 1 in 500-year event.

77. As none of the options have an impact above a minor negative status, although the confidence in this assessment in relation to the groundwater drought permits is denoted as low as they have not been utilised previously, all drought options are classed as feasible.

F. Feasible options and comparison with WRMP19

78. The outcome of the screening process has produced options relating to demand management, hard infrastructure including transfers and drought options. This totals 41 options or option groups, nine demand management activities, 27 hard infrastructure and transfer options and 7 drought options.

79. This exceeds the number produced for the WRMP19 plan, where there were 13 hard infrastructure (supply-side) options and 16 demand-side options. This is to be expected since more options will be needed to solve a more challenging supply demand balance deficit. In addition, we have included more options than we need as a company to ensure there is sufficient capacity in the region as a whole, since many resource zones face a larger deficit than calculated for the SES Water WRZ.

We have set out our stages approach to identify options and the factors considered when developing our options. The unconstrained options list was screened to produce a shortlist of feasible options for the next stage of assessment, and we provide an overview of these feasible options across new supplies, demand management, green infrastructure and drought options.

Costs, including capex, opex, social, environmental and carbon for each option, were calculated. Options relating to catchment management were not found to increase deployable output but are recommended for consideration as part of a wider approach to reducing the need for end-of-pipe solutions such as additional treatment as well as enhancing biodiversity.

SECTION 7

Section 7 Decision making

7. Decision making

In this Chapter we provide a summary of our current plan to ensure we believe it remains fit for purpose, before undertaking a problem characterisation assessment of the resource planning requirements going forward. We set out our approach to adaptive planning, the timing of decision points and pathways, and the necessary monitoring to ensure we are responsive to the future challenges. We provide an overview of the plan programmes we have assessed with investment modelling and set out the results of the optimisation, together with our appraisals of those programmes.

A. Summary of our current plan (WRMP19)

1. Whilst there have been challenges to the delivery of our current plan (published in 2019) we have recovered our activity across the key elements of the plan:
    - We are on track with our leakage reduction activities to meet our performance commitments throughout AMP7.
    - We are undertaking enhanced water efficiency activities following the lockdowns of 2020 and 2021, and most recently achieved postive consumption reductions (2022/23). However, following the lockdowns and change in working patterns, we have seen a shift in per capita consumption and we believe our plan (WRMP24) modelling reflects the likely 2025 starting position.
    - Our universal metering programme suffered a delayed start due to the pandemic lockdowns and, following a recent pause to improve our working practices, we are now aiming to achieve at least 85% metering penetration by 2025, with a proportion of those being smart meters.
    - We are on track to deliver our WINEP commitments which relate to water course improvements, catchment advice and land-based activities in drinking water protected areas and investigations into our abstractions.
    - We are on track to deliver our resileince commitment that ensures all of our customers can be supplied by two treatments works by 2025.
    - We also made a commitment in the plan to carry out further environmental assessments for some of the supply options identified. This has been completed as part of the optioneering work carried out for the regional and draft plan.
2. In preparation for this plan, we have carried out a new forecast at a regional level which includes an assessment of the hidden and transient population (not previously accounted for in the current plan, WRMP19). This results in a slightly higher population at the start of the plan. Other elements of the plan, such as outage and water quality impacts, are largely unchanged in comparison to the forecasts made in the 2019 plan.
3. Based on the above, we do not consider the current plan (WRMP19) itself needs to be updated. We have therefore focused on the requirements from 2025 and set out our decision-making process to develop the proposed plan (WRMP24). The following sections detail the problem characterisation and the evolution of the adaptive pathways.

B. Problem characterisation

4. Problem characterisation is a means of summarising the overall risk to supply to ensure that the method and decision support tools used to resolve any supply and demand deficit is commensurate with the potential level of risk. We have carried out an individual assessment, in line with the *Decision Making Process Guidance*[31] issued from UKWIR, to identify the scale and complexity of the planning problem and our vulnerability to strategic issues, risks and uncertainties.

5. Our assessment was subsequently compared to the assessments of the remaining five companies in the WRSE region so that we could determine an overall level and define the appropriate methods to resolve the resource planning challenge, whilst being proportional to the issues identified in terms of effort and cost.

6. Our assessment results are detailed in Table 42 – setting out a **Strategic Needs Score** (of 4) and a **Complexity Factors Score** (of 9). Compared against the matrix in the guidance gives a level of concern assessment as 'Medium'. This is higher than the assessment results from WRMP19 which was 'Low' – largely arising from our higher level of environmental ambition, our revised deployable output modelling and some uncertainty on demand forecasts following Covid-19. However, in WRMP19 we selected methods which were appropriate for a medium or high level problem characterisation, in line with the *Risk Based Planning Methods*[32] from UKWIR to ensure our plan was sufficiently robust, and therefore the change in assessment level does not mean a change in methodology is necessarily required.

Table 42 Problem characterisation matrix score

Complexity Factors Score ("How difficult is it to solve")	Strategic Needs Score ("How big is the problem?")			
	0-1 (None)	2 to 3 (Small)	4 to 5 (Medium)	6 (Large)
Low (<7)				
Medium (7-11)			SES Water	
High (11+)				

7. Our assessment result compares more favourably with that from the overall region, where many WRSE companies will face significant water supply issues in the near future.

31 WRMP 2019 Methods – Decision Making Process: Guidance (ukwir.org)
32 WRMP 2019 Methods – Risk Based Planning (ukwir.org)

Table 43 Problem characterisation assessment

Area	Type of risk	No Significant Concerns	Moderately Significant Concerns	Very significant concerns	Comments
		0	1	2	
Strategic WRMP Risks					
Level of concern that customer service could be significantly affected by current or future supply side risks, without investment	Supply - side		1		Severe droughts, climate change
Level of concern that customer service could be significantly affected by current or future demand side risks, without investment	Demand side			2	Population growth, demand during drought conditions
Level of concern over the acceptability of the cost of the likely investment programme and/or that the likely investment programme contains contentious options (including environmental/planning risks)	Investment programme		1		Bough Beech dam raising to be considered
Strategic Needs Score (How Big is the Problem?)	**4**				
Supply Side Complexity Factors					
Are there concerns about near term supply system performance, either because of recent Level of Service failures or because of poor understanding of system reliability / resilience under different or more severe droughts than those contained in the historic record? Is this exacerbated by uncertainties about the benefits of operational interventions contained in the Drought Plan?	Supply - side	0			Benefits of operational interventions in Drought Plan relatively low
Are there concerns about future supply system performance, primarily due to uncertain impacts of climate change on vulnerable supply systems, including associated source deterioration (water quality, catchments etc.), or poor understanding?	Supply - side		1		Climate change; Metaldehyde; algal blooms
Are there concerns about the potential for stepped changes in supply (e.g. sustainability reductions, bulk imports etc.) in the near or medium term that are currently very uncertain?	Supply - side		1		Potential for sustainability reductions in several chalk catchments for Environmental Destination ambitions. No bulk imports.
Are there concerns that the DO metric might fail to reflect resilience aspects that influence the choice of investment options (e.g. duration of failure), or are there conjunctive dependencies between new options (i.e. the amount of benefit from one option depends on the construction of another option). These can both be considered as non-linear problems.	Supply - side		1		Potential for long-term outage of sources or WTW. Options to provide supplies to other companies may be dependent on SES supply options.

Area	Type of risk	No Significant Concerns	Moderately Significant Concerns	Very significant concerns	Comments
Demand Side Complexity Factors					
Are there concerns about changes in current or near-term demand, e.g. in terms of demand profile, total demand, or changes in economics / demographics or customer characteristics?	Demand side		1		Covid-19 impacts on home-working and behavioural trends.
Does uncertainty associated with forecasts of demographic / economic / behavioural changes over the planning period cause concerns over the level of investment that may be required?	Demand side		1		Population growth forecasts have a wide range. PCC forecasts over long term (beyond 25 years) uncertain.
Are there concerns that a simple 'dry year / normal year' assessment of demand is not adequate, e.g. because of high sensitivity of demand to drought (so demand under severe events needs to be understood), or because demand versus drought timing is critical?	Demand side		1		More information needed to understand demand under severe drought events.
Investment Programme Complexity factors					
Are there concerns that capex uncertainty (particularly in relation to new or untested technologies) could compromise the company's ability to select a 'best value' portfolio over the planning period?	Investment programme		1		Uncertainty in costs.
Does the nature of feasible options mean that construction lead time or scheme promotability are a major driver of the choice of investment portfolio?	Investment programme		1		Bough Beech dam raising - long lead time.
Are there concerns that trade-offs between costs and non-monetised 'best value' considerations (social, environment) are so complex that they require quantified analysis (beyond SEA) to justify final investment decision?	Investment programme		1		Many best value considerations are relatively new – Biodiversity Net Gain, Natural Capital etc.
Is the investment programme sensitive to assumptions about the utilisation of new resources, mainly because of large differences in variable opex between investment options?	Investment programme	0			
Complexity Factors Score (How difficult is it to solve the problem?)	**9**				

OVERALL LEVEL OF CONCERN Medium

C. Adaptive planning

8. Due to the levels of uncertainty in the planning period, as a region we have opted to use an adaptive planning framework to help us make the right 'best value' investment decisions. This is in line with the Water Resources Planning Guideline. This method is a more sophisticated way of taking key uncertainties into account and is a step forward in comparison to using 'lumped headroom', as we have done in previous plans. The aim is to achieve a balance between allowing flexibility (i.e. not locking in large schemes too early) and being sufficiently proactive so that solutions are in place before they are needed.

9. The key future uncertainties in the supply demand balance are considered to be:

    - Population growth - impacts on demand
    - Climate change – impacts on both supply and demand
    - Environmental destination – impacts on supply

10. There are further challenges to water resource planning, but the above represent components that are most likely to cause significant medium to long-term uncertainty and which, to various degrees, are outside of our direct control. The future scenarios seek to combine the uncertainties so that we plan effectively for the possible futures we will face.

11. We have developed three levels (high, medium and low) of impact for each of the uncertainties over 5-yearly time steps and built these into the adaptive plan framework, so that investment modelling and programme appraisal can define solutions for combinations of the pathways.

12. Population growth and climate change are risk-based triggers with smoother trends whereas environmental destination, which is based on policy decisions relating to step reductions in abstraction, will lead to a corresponding step change in the amount of water available for supply. More information on the impacts of the range in scenarios, in terms of demand and supply, is considered in Chapters 3 and 4.

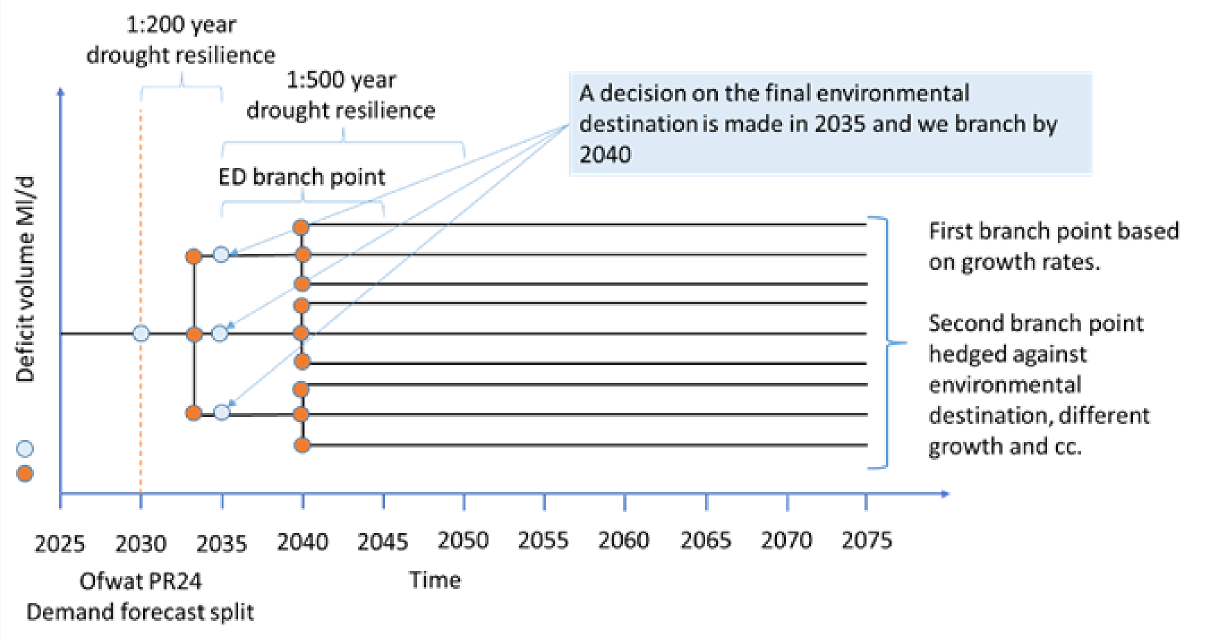
13. The possible pathways are assumed to be equally probable, and although one pathway will be selected to represent the 'preferred plan', this does not infer that it is calculated to be more likely to occur than the others.

Timing of decision points

14. As we develop pathways that can support a range of futures, we need to consider the timing of decision points when we may need to 'branch' to an alternative pathway and appropriately adapt to a possible changing future. Feedback on the emerging regional plan challenged the timing of initial branch points. Further sensitivity with the region evolved the timing – bringing forward the branch points from 2040 and 2060, to 2035 and 2040.

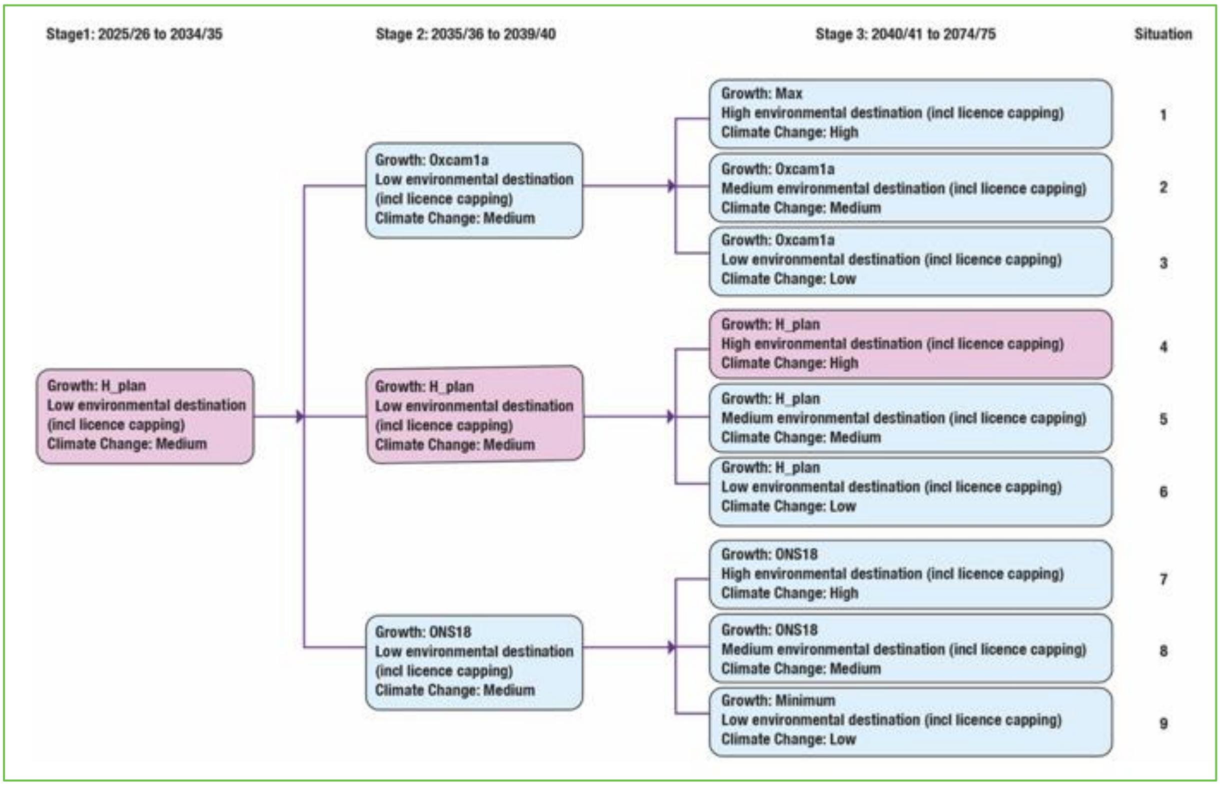
15. Based on the revised timing, there are three pathways from 2035, and nine pathways from 2040. This allows us to be more responsive at an earlier stage in the planning period, as illustrated in Figure 24

Figure 25 Regional adaptive pathways and matrix of uncertainties



16. Each of the adaptive pathways is referred to as a situation, and Figure 25 gives the detail on which scenario was used in each of the nine situations.

Figure 24 Regional adaptive pathways and matrix of uncertainties



Our adaptive components

17. We have covered that the key uncertainties affecting resource planning are population growth, climate change and environmental destination. We have set out the branches relating to our forecast and profiles, as follows:

18. For population growth, at the first branch point the three selected scenarios are:

- • High – housing plan including OxCam projections
- • Medium – housing plan (baseline projection based on bottom-up forecast)
- • Low – ONS18

19. At the second branch point in 2035, the above scenario is still used but we have introduced the maximum growth projection for Situation 1 (which in our case is ONS-14 High) and the minimum growth projection for Situation 9 (which in our case is ONS18-Low).

20. For environmental destination, after the first branch point the same scenario is used – termed *licence cap* since it is based on the abstraction reductions needed to achieve the legally required level under the Environment Agency assessment (detailed in Chapter 3B). From the second branch point, the branches divide into low, medium and high levels of potential abstraction reductions.

21. For climate change, up to the second branch point the median level is used. From 2040 onwards, the high projection (scenario CC06) and low projection (scenario CC07) is used so that there are a range of combination with the different population growth and environmental ambition scenarios.

22. Figure 25 also illustrates that the decision points to determine which pathway should be taken needs to occur before the year of the actual branch point. This is particularly relevant to the environmental destination investigations (covered in Chapter 3B), with the outcome of these built into future iterations of our WRMP and business plans, coming into effect up to 2035.

23. **Situation 4** is highlighted, and used as our reported pathway, as this follows:

- the housing plan growth forecast (in line with Guideline), and referenced as our medium scenario,
- a median level of climate change (used as our medium scenario), and
- a high level of environmental destination following the second decision point to ensure we reach the environmental flow indicator by 2050 (used as our high scenario).

Ofwat common reference scenarios

24. As specified by the planning Guideline, we have compared the factors selected to those identified as Ofwat's common reference scenarios, defined in *PR24 and beyond: Final Guidance on long-term delivery strategies*[33] and presented below (Figure 26).

25. Whilst the three components of water resource adaptive planning are aligned with the common reference scenarios, Ofwat have defined a fourth scenario – technology. In water resources terms this relates to potential shifts in ways to tackle both reducing demand, for example through smart metering, and ways to increase supply, such as advanced treatment to reduce the cost of using effluent. This scenario has been included in the plan during the testing stages, to explore the impact of technology advancements on the options selected. In addition, we have also utilised opportunities within our own company

33 PR24-and-beyond-Final-guidance-on-long-term-delivery-strategies_Pr24.pdf (ofwat.gov.uk)

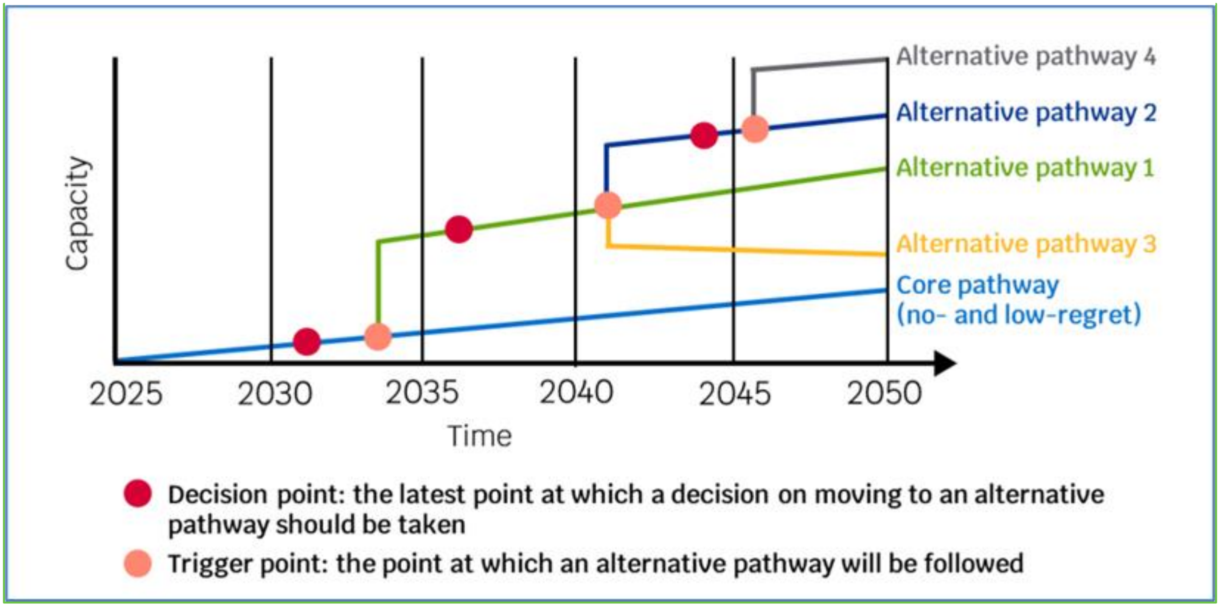
assessments, such as our demand management strategies, to feed into the investment modelling for this plan.

26. Ofwat's guidance defines the '**core pathway'** as the company preferred approach to achieve ambition and vision. It is also referred to as the pathway of **'no or low' regrets**. All other pathways are additive to this (Figure 27).

Figure 26 Ofwat common reference scenarios

	Climate change	Technology	Demand	Abstraction reductions	Wider scenarios
'Adverse' scenarios	**High:** RCP8.5	**Slower:** slower development than expected	**High:** higher growth forecasts	**High:** 'Enhanced' scenario (in England)	Material **local or company-specific factors**, as appropriate
'Benign' scenarios	**Low:** RCP2.6	**Faster:** faster development than expected	**Low:** lower growth forecasts and legislation on building regulations and product standards	**Low:** Current legal requirements (in England and Wales)	Parameters **between the reference scenarios**, e.g. a 'medium' scenario, as appropriate
	Mandatory Impacts presented separately				**Discretionary** Can be combined if plausible

Figure 27 Ofwat figure setting out core and alternative pathway structure



27. This approach does not propose to combine the factors, and therefore the range of plausible solutions will be narrower than we have explored in the regional and company plan. We discuss our interpretation of Ofwat's expectations and the associated alignment of our plan in Chapters 7 and 8.

Adaptive planning and headroom

28. The standard model of calculating headroom is to create an allowance for each component of the plan, based on the range of outcome values that could occur – creating a buffer to ensure sufficient supplies are available. Our headroom assessment considers the components not covered by the adaptive plan, whilst ensuring uncertainty is not double counted in both the adaptive planning and headroom assessment. We set out which components are calculated separately in Chapter 5B.

Monitoring

29. Monitoring forms a key element of our regulation and forward business planning. To ensure we are prepared for where the future may take us, and to ensure this plan remains optimal for customers and the environment, we will need to monitor specific components. We consider some categories will have greater significance to the plan, and other components will bear insight to our activities/performance and strategy (and may ultimately feed into the regional outlook). We are currently developing our monitoring, together with the region, and we believe the following categories are relevant:

	Component	Rationale	Monitoring	Stakeholders
		External factors affecting adaptive pathways		
Population growth	Population growth (unit)	Review population trends against low, medium and high growth profiles.	Ongoing population forecasts, recorded in regulated annual reporting. Annual monitoring to remain in case trends are earlier than expected trigger point.	Regional companies and WRSE, in the event population is diverging from expected growth forecasts and preferred plan.
Population growth	New properties (unit)	Review whether new connections (properties) are matching expected level of growth.	Developer enquiries will indicate level of homes coming 'on-line', and allow us to assess any immediate risks to delivery of the plan due to immediate population growth.	
Climate	Climate change	Assess whether climate change is in line with specific projections and the associated impacts on supply.	Climate accounting reports and insights, such as from the Met Office, the Climate Change Committee and the Intergovernmental Panel on Climate Change (IPCC).	Regional companies and WRSE, in the event climate change is aligning to specific projections that inform our adaptive pathway.
Environmental destination	Profile of abstraction reductions	Define a revised set of abstraction profile reductions based on AMP8 investigations that may alter supply forecast.	Static levels of abstraction reduction and operational constraints that may arise to deliver preferred profile.	Regional companies and WRSE, in the event environmental destination is altered and affects supply forecasts.

Company specific monitoring and performance				
Note: the external factors above are intended to form part of the overall company level monitoring, thereby informing local decision making together with the factors below.				
Demand	Distribution input (DI, known as demand) (Ml/d)	Assess whether DI is meeting expected levels as this will enhance our assessment of population growth and proficiency of our demand management strategies.	Our annual DI record, presented in our Annual Review submission to the Environment Agency.	Business leadership in the event DI trend (and further components) require corrective action and if there is a risk to customer supply. Companies due to receive bulk supplies. WRSE in the event DI indicator is showing differing picture to population trends.
Climate change	Experienced weather (continuous data)	Interpret experienced weather against historical patterns to inform rate of change.	Ongoing weather recording, including rainfall and temperature from company sites.	Business leadership and operation, with upward knowledge to regional groups where experienced weather is impacting supply availability.
	Outage (discrete data)	Interpret impact and frequency of outages on operational performance.	Third party (electricity provider) outage reporting.	Business leadership and operation to inform business planning to maintain/enhance asset resilience as required.
Environmental destination	As above	As above		

30. Consultation to our draft plan outlined that some local authorities are preparing a new Local Plans which will include significant growth compared to the adopted Local Plans. We have noted that some local authorities may have discrepancies between their adopted and proposed updates to their Local Plans, and we are reassured that the adaptative pathway can account for higher and lower population growth than the preferred pathway. As such, we would be able to alter our pathway in the event population growth follows a higher trajectory.

D. Integrating the best value planning metrics

31. Following definition of the value metrics in Chapter 2, we need to practically implement the scoring/value criteria. In previous plans, environmental evaluation has predominantly been assessed as part of a Strategic Environmental Assessment (SEA) of the proposed programme, alongside Water Framework Directive (WFD) assessments and Habitats Regulation Assessments (HRA) with only a preliminary assessment prior to that point.

32. Regionally we commissioned a scoping study to be carried out to review best practice in order to propose an initial environmental assessment framework. It was determined that an innovative and flexible approach was required that could be applied at a regional and sub-regional level, incorporating techniques such as Biodiversity Net Gain (BNG), Natural Capital (NC) and ecosystem services assessment. It was also identified that the assessment workstream would need to consider the approaches being developed by the Environmental Ambition and Environmental Engagement workstreams, due to the inter-relationships between them.

33. We have followed this framework in assessing our options, from the screening stage, to detailed assessment and full programme appraisal as part of the multi-criteria optimisation.

34. The objective of the framework is to better account for long-term environmental and customers' needs that is transparent, evidence-based and robust to scrutiny. It also sought to demonstrate how SEA techniques can evolve to integrate new ecosystem services approaches and natural capital assessment at the regional level. A wide range of stakeholders' views were sought during the scoping and subsequent stages of the framework creation.

35. The key steps include:

- Qualitative assessment to determine which indicators are relevant to each option, in the form of benefit (+), disbenefit (-) or no impact (0)
- Defining the spatial scale using open source GIS datasets on biodiversity and social, recreational and health impacts
- Quantitative assessment of benefits and disbenefits
- Natural capital assessment and monetisation

36. The final stage of assessment, after the programmes are at the draft stage, is to carry out an in-combination and cumulation effects assessment to ensure there are not any additional cross-boundaries impacts that were not identified at an individual company level.

Net zero and carbon

37. As one of the more energy-intensive sectors in the UK and therefore a contributor to emissions, the water industry has set itself the stretching target to achieve operational net zero emissions by 2030 through a Public Interest Commitment.

38. We have committed in the regional plan to follow national best practice on reaching net zero and we are currently reviewing our own *route to net zero* plans, in line with Ofwat's methodology for business planning beyond 2025.

E. Defining our plan programmes

39. Drawing together the development of best value planning framework and metrics; our forecasts and problem characterisations; and our suite of options, we are able to use investment modelling tools to determine programme options which we can review and

tailor. Some options are not required to meet demand, but to meet headroom. These are classified as 'not utilised' in the model run outputs.

40. We have undertaken further modelling since publishing our draft plan for consultation, owing to:

- a revision of the Water Resource Planning Guideline,
- additional expectations of water companies following publishing of the Environmental Improvement Plan and Defra's Integrated Plan for Water,
- various company updates into the regional investment modelling based on separate regional changes, updates to accuracy and considerations of ongoing scheme deliverability.

41. The revised output of the modelling and appraisal is provided below.

Least cost plan

42. The Least Cost Plan approach is based on an **economics of balancing supply and demand** (EBSD) aggregated approach. We are required to produce a least cost programme, that meets our statutory requirements, as a benchmark to appraise the other programmes.

43. For the least cost plan, the investment model produces a programme of investments over the planning period to meet the defined planning challenge – for each of the adaptive plan branches – in the most cost-effective way of balancing supply and demand.

44. The optimisation routine finds the combination of decisions which together minimise the discounted cost of the investment programme – this computation converts future cash flows to a present-day value, known as net present value (NPV). As such, costs incurred far into the future are most heavily discounted. This encourages the model to delay expenditure in the optimised plan.

45. The optimal programme will generally consist of multiple options activated in different start years which combine to give an overall least cost solution. Different planning conditions that may arise within year are accounted for by using planning scenarios - Dry Year Annual Average (DYAA) and Dry Year Critical Period (DYCP).

46. We added a constraint to the model relating to our demand management strategies, to ensure the selected strategy aligned with the expectations on us from the Environmental Improvement Plan. In addition, the Government intervention profile has been defined to set out savings of 0.30Ml/d in AMP7, with an increased profile in AMP8 (0.62Ml/d) and AMP9 (1.28Ml/d). Costs are not attributed to this option.

47. Other than this constraint, we made a conscious decision throughout the least cost model runs and appraisal not to interfere with the investment model's objective assessment of a least cost plan.

48. An overview of the revised least cost programme, highlighting the selected options, is presented below detailing the option, the programme for that option and utilisation in (Ml/d) at intervals of the planning horizon. Drought permits continue to feature across programmes to manage extreme drought, but these would not be relied upon as part of our operational planning.

Table 44 Least Cost Plan (Situation 4, DYAA)

Option	Programme	Utilisation at 2034/35 (Ml/d)	Utilisation at 2049/50 (Ml/d)	Utilisation at 2064/65 (Ml/d)
Consumption Reduction Activities (High+)	From 2025/26	12.88	18.43	23.25
Leakage Reduction Activities (High+)	From 2025/26	6.20	9.25	9.25
Government Interventions (HybridC++)	From 2025/26	4.66	20.52	20.93
SES Water to Southern Water (4Ml/d) Note: only utilised at 4.0Ml/d until 2030/31	2025/26 to 2030/2031	-	-	-
SES Water to Southern Water (10Ml/d) ‘Outwood to Turners Hill’	From 2033/34	10.00	2.42	6.83
SES Water to South East Water (10Ml/d) ‘Bough Beech to Riverhill’	From 2038/39	-	10.00	10.00
SES Water to South East Water (5Ml/d) ‘Outwood to Whitely Hill’	From 2039/40	-	5.00	5.00
SES Water to Thames Water (15Ml/d) ‘Cheam to Merton’	From 2049/50	-	10.52	15.00
Outwood Lane groundwater (2.7Ml/d)	From 2049/50	-	2.66	2.66
Raising Bough Beech reservoir (11.5Ml/d)	From 2050/51	-	-	11.5
Water Lane borehole enhancement (2.2Ml/d)	From 2050/51	-	-	2.2
Secombe Centre UV (2.1Ml/d)	From 2050/51	-	-	2.07
Duckpit Wood (1.4Ml/d) Utilised at 1.37Ml/d from 2067/68	From 2067/68			

49. As anticipated from our draft plan optimisation, the model continues to optimise our least cost programme to support transfers to other water resource zones. Our programme appraisal during the emerging and draft plan highlighted several transfers that we were not prepared to commit to. We accept as a principle that the nature of regional planning, and our location within the region’s geography, provides the investment model with a series of options to use our resources and network to support other companies and be a conduit for water transfers.

50. Early iterations of the model indicated occasions where transfers made a majority proportion of our demand, which we considered unfairly disadvantaged our customers and environment. We have therefore sought to maintain an appropriate balance between our

surplus water and the needs of others in the region, so that we can remain confident in the deliverability of the plan.

51. The *draft* least cost programme provided for up to five transfers (one being bidirectional) and outlined 33.5Ml/d being required for exports at 2054/55. The revised optimisation suggests we would need to export 37.3Ml/d in the same year. Due to the level of increased consumption savings, and therefore relative surplus, we consider the proposed transfers of the revised least cost plan remains proportionate to our role in the region.

52. Support is provided to Southern Water from the 2025/26 to 2030/31, which forms a new option for the model to consider. This arose from discussions with Southern Water and a need for essential increased supply to their region to support their ongoing works to reduce dependence on a sensitive catchment. We anticipate this option will feature in all programmes to ensure they maintain a supply demand balance.

53. Analysis for the Dry Year Critical Period (DYCP) scenario within the least cost modelling highlighted reduced utilisation of the proposed exports to other companies. In particular, the Outwood to Whitley Hill option falls away from the programme and requirement of the Duckpit Wood supply scheme is removed.

Best environmental social plan

54. To reach proposed programmes for the best environmental social plan, the environmental and social metrics are optimised in uniform increments to reach improved optimisations whilst maintaining a supply demand balance. This alternative programme is required to comply with the Guideline.

55. For consistency, we have used the overview table to set out the options selected within the best environmental social plan.

Table 45 Best Environmental Social Plan (Situation 4, DYAA)

Option	Programme	Utilisation at 2034/35 (Ml/d)	Utilisation at 2049/50 (Ml/d)	Utilisation at 2064/65 (Ml/d)
Consumption Reduction Activities (High+)	From 2025/26	12.88	18.43	23.25
Leakage Reduction Activities (High+)	From 2025/26	6.20	9.25	9.25
Government Interventions (HybridC++)	From 2025/26	4.66	20.52	20.93
SES Water to Southern Water (4Ml/d) Note: only utilised at 4.0Ml/d until 2030/31	2025/26 to 2030/2031	-	-	-
SES Water to Southern Water (10Ml/d) ‘Outwood to Turners Hill’	From 2033/34	10.00	10.00	10.00
SES Water to South East Water (10Ml/d) ‘Bough Beech to Riverhill’	From 2038/39	-	10.00	10.00
SES Water to South East Water (5Ml/d) ‘Outwood to Whitely Hill’	From 2050/51	-	-	5.00

Option	Programme	Utilisation at 2034/35 (Ml/d)	Utilisation at 2049/50 (Ml/d)	Utilisation at 2064/65 (Ml/d)
Outwood Lane groundwater (2.7Ml/d)	From 2050/51	-	-	2.66
Secombe Centre UV (2.1Ml/d)	From 2050/51	-	-	2.07
SES Water to Thames Water (15Ml/d) 'Cheam to Merton'	From 2052/53	-	-	11.83
Raising Bough Beech reservoir (11.5Ml/d)	From 2052/53	-	-	11.5
Water Lane borehole enhancement (2.2Ml/d)	From 2054/55	-	-	2.2
Duckpit Wood (1.4Ml/d) Utilised at 1.37Ml/d from 2068/69	From 2068/69	-	-	-

56. This optimisation sees broadly the same suite of options, albeit the timings alter so that we develop transfer and source options slightly later than the least cost programme. For us, this reduces the operational costs of options we would bear (following construction) and therefore also reduces the cost of the environmental social programme, compared to the least cost programme. This is not reflected across the region[34].

57. We consider that the low level of variability in the transfers and supply options (other than timings) reflects a resilience to changes across the region and company plans.

58. Similarly to the least cost plan, when reviewing the best environmental social plan under a DYCP scenario the investment model highlights several changes to the proposed transfers. This includes the removal of the Outwood to Whitely Hill transfer to South East Water and reduced/delayed utilisation of the remaining transfers. However, the supply options remains present in the programme.

Best value plan

59. To develop the best value plan, the value metrics are uniformly optimised across all the best value plan metrics until the investment model reaches an optimum improvement whilst maintaining the supply demand balance.

Table 46 Best value programme (Situation 4, DYAA)

Option	Programme	Utilisation at 2034/35 (Ml/d)	Utilisation at 2049/50 (Ml/d)	Utilisation at 2064/65 (Ml/d)
Consumption Reduction Activities (High+)	From 2025/26	12.88	18.43	23.25
Leakage Reduction Activities (High+)	From 2025/26	6.20	9.25	9.25
Government Interventions (HybridC++)	From 2025/26	4.66	20.52	20.93

34 Regional least cost plan £19.052m; regional environmental social plan £19.383m.

Option	Programme	Utilisation at 2034/35 (Ml/d)	Utilisation at 2049/50 (Ml/d)	Utilisation at 2064/65 (Ml/d)
SES Water to Southern Water (4Ml/d) Note: only utilised at 4.0Ml/d until 2030/31	2025/26 to 2030/2031	-	-	-
SES Water to Southern Water (10Ml/d) 'Outwood to Turners Hill'	From 2033/34	10.00	10.00	10.00
SES Water to South East Water (10Ml/d) 'Bough Beech to Riverhill'	From 2038/39	-	10.00	10.00
SES Water to South East Water (5Ml/d) 'Outwood to Whitely Hill'	From 2048/49	-	5.00	5.00
Outwood Lane groundwater (2.7Ml/d)	From 2048/49	-	0.00	2.32
Secombe Centre UV (2.1Ml/d)	From 2054/55	-	-	2.07
Water Lane borehole enhancement (2.2Ml/d)	From 2061/62	-	-	2.20

60. Optimising the best value metrics, the investment model has identified alternative solutions for other companies in the region to maintain their supply demand balance. This includes:

- the development of South East Water's option at Arlington Reservoir to support their demand needs, and
- the improved utilisation of Thames Water's options – possibly as a result of reduced transfers between Thames Water and Affinity Water – to support their demand needs.

61. As a result, there is a reduced reliance on sources from our water resource zone, and therefore reduced need for hard infrastructure. We consequently see two supply schemes – the raising of Bough Beech and Duckpit Wood – optimised out of our best value plan in Situation 4.

62. We consider that the raising of Bough Beech being optimised out of the programme on the preferred pathway aligns with our intention to develop a series of nature-based solutions across the Eden catchment, thereby supporting a more resilient catchment without the need for hard infrastructure to maintain our supply demand balance. We have outlined our environmental ambition and proposals for this catchment in Chapter 3B.

63. Nonetheless, the best value programme does indicate that in a high growth scenario (Situation 1), we would need the additional resilience from raising Bough Beech. This has informed our business strategy and must be considered as part of our monitoring plan; due to the significant investment this would require. We have discussed this as part of next section, Chapter 8.

Table 47 Overview of metric scoring from optimised programmes (Situation 4)

Metric	Least cost plan values	Best environmental social plan values	Best value plan values
Cost (STPR) (£m)	£544.0	£542.0	£534.0
Regional cost (STPR) (£m)	£19,052	£19,383	£19,255
Emissions (capital)	11,291	10,442	1,084
Emissions (operational)	293,483	293,483	293,483
*Environmental (SEA environmental benefit)	67,149	68,530	67,933
Environmental (SEA environmental benefit)	2,137	2,482	2,407
*Environmental (SEA environmental disbenefit)	99,769	102,686	97,446
Environmental (SEA environmental disbenefit)	3,568	3,670	2,806
*Environmental (natural capital)	75,242,446	82,655,298	81,015,364
Environmental (natural capital)	-13,128	-13,020	0
*Biodiversity net gain (required replacement)	-204,324	-172,101	-199,827
Biodiversity net gain (required replacement)	-849	-804	0
*Social (customer preference)	33,042	36,736	36,555
Social (customer preference)	719	772	720
*Reliability	28.30	26.77	29.24
Reliability	0.449	0.457	0.458
*Adaptability	14.20	13.64	14.39
Adaptability	0.137	0.137	0.141
*Evolvability	18.73	18.72	19.63
Evolvability	0.415	0.418	0.434
*Indicative bill impact (£) at 2035	£81.77	£80.81	£43.90

*denotes region wide metric values.

64. The best value plan denotes a further reduction in costs based on the reduced need for us to construct supply options. As before, this is not reflected across the region and Table 47 provides the indicative regional costs across each programme for reference. We have also included the disaggregated values of each metric across the plan programmes.

Ofwat core programme

65. In addition to the programmes covered above, we are required to set out a 'core programme' to support Ofwat's review of our plan needs in context of the PR24 business plan requirements. The areas expected to be addressed are as follows:

- Identification of optimised long-term programmes using long-term targets.
- Full consideration of a wide range of options to meet long-term challenges
- Development of a best value plan using efficient costs and robust valuation of benefits
- Presentation of an adaptive plan to address known issues and future uncertainties tested against a suitable range of scenarios
- Demonstration that stakeholder and customer views have been taken into account, and that partnership opportunities have been identified to enable co-funding and codelivery.

66. We believe our best value planning framework aligns with this approach, however, Ofwat's common reference scenarios (covered in Chapter 7C) are narrower than the full range we have considered when developing our adaptive planning approach. We have therefore reviewed the situation pathways to assess an appropriate core programme, and consider the following approach aligns with Ofwat's requirements:

- a housing plan growth forecast (in line with Guideline), and referenced as our medium scenario, that branches to an ONS18 growth forecast,
- a median level of climate change (used as our medium scenario), and
- a medium level of environmental destination to balance our current legal requirement of no abstraction reductions together with clear customer support we have to protect and enhance the environment.

67. These factors align with Situation 8 of the best value programme, and we have set out an overview of the options selected for this situation below.

Table 48 Best value programme ~ Ofwat core (Situation 8, DYAA)

Option	Programme	Utilisation at 2034/35 (Ml/d)	Utilisation at 2049/50 (Ml/d)	Utilisation at 2064/65 (Ml/d)
Consumption Reduction Activities (High+)	From 2025/26	12.88	18.43	23.25
Leakage Reduction Activities (High+)	From 2025/26	6.20	9.25	9.25
Government Interventions (HybridC++)	From 2025/26	4.66	20.52	20.93
SES Water to Southern Water (4Ml/d) Note: only utilised at 4.0Ml/d until 2030/31	2025/26 to 2030/2031	-	-	-
SES Water to Southern Water (10Ml/d) 'Outwood to Turners Hill'	From 2033/34	10.00	10.00	10.00
SES Water to South East Water (10Ml/d) 'Bough Beech to Riverhill'	From 2039/40	-	0.48	10.00

68. The plan remains similar to the reported pathway (Situation 4) in the first 15 years to 2039/40. From 2040 a proposed transfer to South East Water also remains in the adaptive plan, but is utilised one year later and at a relatively lower capacity, until 2063 when it is fully utilised.

69. Based on the lower growth rate and reduced environmental ambition, the investment modelling also identifies a reduced need to support South East Water. Therefore, the second transfer, 'Outwood to Whitely Hill', is not identified as being required. Two smaller supply options to enhance our resources, previously identified in 2054/55 and 2062/63 are also no longer required.

We have characterised a medium level of concern to our water resource planning requirement and provided further detail on the practical implementation of adaptive planning in our proposals. We have set out the components across the adaptive plans, detailing profiles for population growth, climate change and environmental destination.

We have set out the monitoring we believe will be required to make assessments at each decision point, together with additional criteria we can monitor to inform our continued business decision making.

We have compared the outputs of three programmes - the least cost plan, the best value plan and best environmental and social plan. We have assessed the options needed to satisfy the supply-demand deficit – and acknowledged that the best value plan also improves the cost metrics for our water resource zone due to reduced reliance on our resources from other companies.

We have reviewed the Ofwat common reference scenarios and interpreted this in a pathway, setting out the requirements of the programme to draw out specific comparison in the next Chapter.

SECTION 8

Section 8 Our preferred plan

8. Our preferred plan

In this Chapter, we set out the various challenges and sensitivities associated with the best value plan so that we can inform our programme refinement and define the additional monitoring required. We draw a comparison of the preferred plan with Ofwat's core programme, including the associated costs, and we provide an overview of the bill impact. We set out the environmental impact of our plan and their cumulative effect in our area and the wider region. Finally, we detail how the plan will be interpreted into our regulated business planning.

A. Challenges to the plan

1. Our consultation on the draft plan, together with ongoing engagement with our Board, stakeholders, and customers, has continued to provide appropriate challenge in developing our preferred plan.
2. The challenging interim targets of the Environmental Improvement Plan, to reduce consumption and demand, and our revised demand strategies presents risk to our deliverability and whether we can appropriately adapt. This may, for example, affect our ability to support other regional companies or require us to consider planning for additional options in advance of their anticipated requirement.
3. We have undertaken several assessments across our options to inform our understanding of deliverability and have completed additional sensitivity analysis on the best value plan. This work has informed our business strategy and monitoring we believe is appropriate for our plan.

B. Timing and scale of options

Preferred (reported) pathway (Situation 4)

4. We have firstly set out the best value plan below (as outlined in the previous Chapter) to provide additional detail on the programme appraisal and adaptive pathway needs.

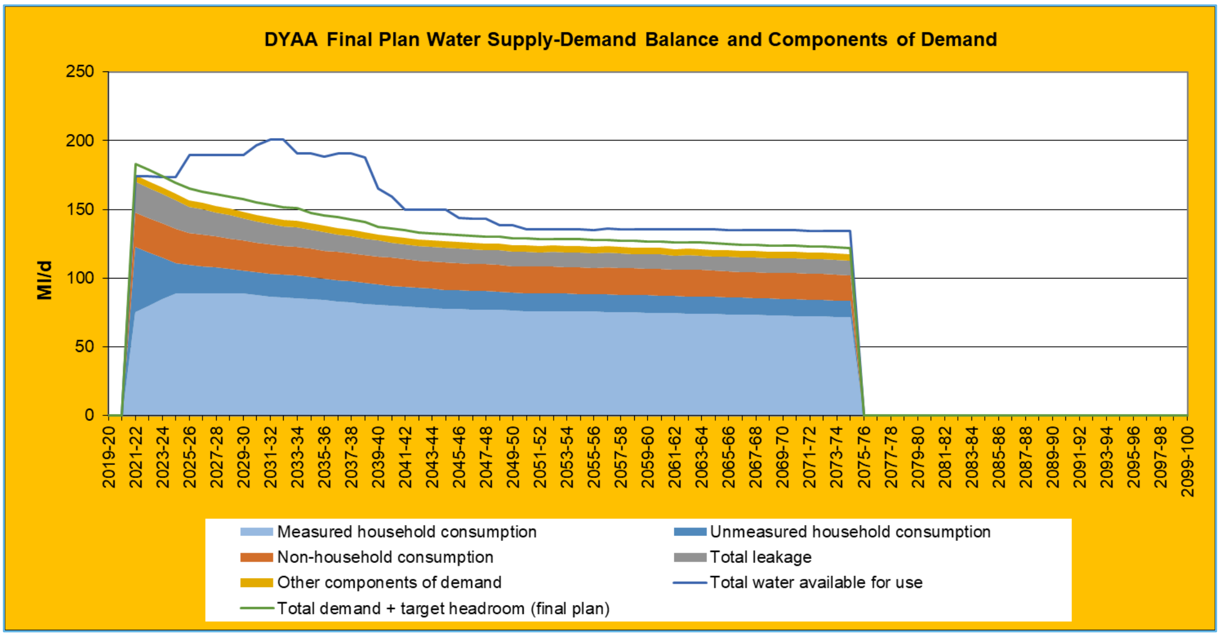
Table 49 Best value plan (Situation 4, DYAA)

Option	Programme	Utilisation at 2034/35 (Ml/d)	Utilisation at 2049/50 (Ml/d)	Utilisation at 2064/65 (Ml/d)
Consumption Reduction Activities (High+)	From 2025/26	12.88	18.43	23.25
Leakage Reduction Activities (High+)	From 2025/26	6.20	9.25	9.25
Government Interventions (HybridC++)	From 2025/26	4.66	20.52	20.93
SES Water to Southern Water (4Ml/d)	2025/26 to 2030/2031	-	-	-

Option	Programme	Utilisation at 2034/35 (Ml/d)	Utilisation at 2049/50 (Ml/d)	Utilisation at 2064/65 (Ml/d)
Note: only utilised at 4.0Ml/d until 2030/31				
SES Water to Southern Water (10Ml/d) 'Outwood to Turners Hill'	From 2033/34	10.00	10.00	10.00
SES Water to South East Water (10Ml/d) 'Bough Beech to Riverhill'	From 2038/39	-	10.00	10.00
SES Water to South East Water (5Ml/d) 'Outwood to Whitely Hill'	From 2048/49	-	5.00	5.00
Outwood Lane groundwater (2.7Ml/d)	From 2048/49	-	0.00	2.32
Secombe Centre UV (2.1Ml/d)	From 2054/55	-	-	2.07
Water Lane borehole enhancement (2.2Ml/d)	From 2061/62	-	-	2.20

5. Planning for a dry year, the supply demand balance for the preferred pathway outlines that we would not require a reliance on demand side drought interventions to maintain the demand needs of our own customers. However, to fulfil an export required to support South East Water from 2048/49, the model has identified the use of demand-side restrictions (in drought) to maintain the full supply demand balance.
6. Separately, we are aware that our anticipated demand savings (which every company in the region is also working to achieve) provide the expected capacity to fulfil the transfers outside of our region. As such, companies would be planning to utilise our water resource at the risk we achieve the necessary supply surplus from reductions in consumption.
7. We have appraised this directly with South East Water, to ensure that the service we provide our customers is not compromised to support other resource zones. South East Water are anticipating developing alternative source options to the transfers being considered in this plan, so that they can reduce the associated risks to their supply demand balance. As such, we expect that in future iterations of the plan, the transfers may not form part of an optimised programme. Where they continue to feature, we will appraise their suitability.
8. We have therefore taken this forward to consider as part of **monitoring plan** so that South East Water – and other recipients – may be informed of the continued viability of future transfers.
9. An overview of the supply demand balance for the reported pathway, extracted from our data table, is provided below (Figure 28).

Figure 28 Final plan supply demand balance (DYAA)



10. Table 49 below sets out in red the changes to all exports (either in their entirety or reduced utilisation) as companies operate under critical period assessments of their own sources to maintain supply.

Table 50 Best Value Plan (Situation 4, DYCP)

Option	Programme	Utilisation at 2034/35 (Ml/d)	Utilisation at 2049/50 (Ml/d)	Utilisation at 2064/65 (Ml/d)
Consumption Reduction Activities (High+)	From 2025/26	12.88	18.43	23.25
Leakage Reduction Activities (High+)	From 2025/26	6.20	9.25	9.25
Government Interventions (HybridC++)	From 2025/26	4.66	20.52	20.93
SES Water to Southern Water (4Ml/d) Note: only utilised between 1.76Ml/d to 4.0Ml/d until 2030/31	2025/26 to 2030/2031	-	-	-
SES Water to Southern Water (10Ml/d) 'Outwood to Turners Hill'	From 2039/40	-	10.00	10.00
SES Water to South East Water (10Ml/d) 'Bough Beech to Riverhill' Note: only utilised 2.44Ml/d in 2038/39	From 2038/39	-	-	-

Option	Programme	Utilisation at 2034/35 (Ml/d)	Utilisation at 2049/50 (Ml/d)	Utilisation at 2064/65 (Ml/d)
SES Water to South East Water (5Ml/d) 'Outwood to Whitely Hill'	Not utilised	-	-	-
Outwood Lane groundwater (2.7Ml/d)	Not utilised	-	-	-
Secombe Centre UV (2.1Ml/d)	Not utilised	-	-	-
Water Lane borehole enhancement (2.2Ml/d)	Not utilised	-	-	-

11. Similar to comments relating to the dry year critical period scenarios of other programmes (commented on in Chapter 7), investment modelling outlines a reduced reliance on our sources to support other water resource zones.

High growth, high climate scenario (Situation 1)

12. Under the more extreme scenario of experiencing population growth to the higher forecast, climate change impacts to the upper forecast and maintaining a high level of environmental destination, the investment model has optimised the following options.

Option	Programme	Utilisation at 2034/35 (Ml/d)	Utilisation at 2049/50 (Ml/d)	Utilisation at 2064/65 (Ml/d)
Consumption Reduction Activities (High+)	From 2025/26	12.88	18.43	23.25
Leakage Reduction Activities (High+)	From 2025/26	6.20	9.25	9.25
Government Interventions (HybridC++)	From 2025/26	4.66	20.52	20.93
SES Water to Southern Water (4Ml/d) Note: only utilised at 4.0Ml/d until 2030/31	2025/26 to 2030/2031	-	-	-
SES Water to Southern Water (10Ml/d) 'Outwood to Turners Hill'	From 2033/34	10.00	10.00	10.00
SES Water to Thames Water (15Ml/d) 'Cheam to Merton'	From 2039/40	-	0.75	0.75
SES Water to South East Water (10Ml/d) 'Bough Beech to Riverhill'	From 2038/39	-	10.00	10.00
SES Water to South East Water (5Ml/d) 'Outwood to Whitely Hill'	From 2039/40	-	5.00	5.00
Raising Bough Beech reservoir (11.5Ml/d)	From 2047/48	-	8.05	11.50
Outwood Lane groundwater (2.7Ml/d)	From 2049/50	-	2.66	2.66

Option	Programme	Utilisation at 2034/35 (Ml/d)	Utilisation at 2049/50 (Ml/d)	Utilisation at 2064/65 (Ml/d)
Secombe Centre UV (2.1Ml/d)	From 2054/55	-	-	2.07
Water Lane borehole enhancement (2.2Ml/d)	From 2053/54	-	-	2.20

13. The additional transfer to Thames Water is highlighted at an initial utilisation of 14.45Ml/d in 2039/40, before tailing down to 3.23Ml/d the year after and becoming a consistent 0.75Ml/d from thereon (as indicated above). We are aware of the relatively significant costs Thames Water may bear to fulfil the initial requirement, only to operate the option in the longer term at a reduced capacity. We do not believe this would materially affect our monitoring, but consider that this transfer may be better optioneered for the required level of utilisation to avoid potentially abortive costs.

14. This scenario also requires the resilience provided by raising Bough Beech reservoir, utilised from 2047/48. Based on the ten-year lead in time for this option, the **monitoring plan** must consider the various components that identify whether we (and the region) should adapt to this pathway.

Ofwat core programme, low growth scenario (Situation 8)

15. Situation 8, which we commented on in Chapter 7D as aligning with the Owat core programme, follows a lower population growth scenario whilst maintaining a median level of climate change impacts and a medium profile of environmental destination. The investment modelling sets out the need to support three transfers:

- an initial 4Ml/d transfer to Southern Water (as with all plan programmes and scenarios),
- a 10Ml/d transfer to Souther Water (Outwood to Turners Hill) from 2033/34, and
- a 10Ml/d transfer to South East Water (Bough Beech to Riverhill) from 2039/40.

16. No additional supply options are outlined under this scenario.

17. To support alignment between this plan and our forthcoming submission to Ofwat for our business plans, we need to set out the key differences between the two programmes. Whilst we have provided overviews of the plans, we have prepared the following table to clearly set out the different option selections and when costs between the programmes may vary.

Table 51 Comparison between preferred (reported) pathway and Ofwat core programme

Option	Preferred plan	Ofwat core programme	Comments
Consumption Reduction Activities (High+)	From 2025/26	From 2025/26	High+ proposals included in both to align with expectations of the EIP.
Leakage Reduction Activities (High+)	From 2025/26	From 2025/26	High+ proposals included in both to align with expectations of the EIP.
Government Interventions (HybridC++)	From 2025/26	From 2025/26	Same level of government interventions assumed across both programmes.

Option	Preferred plan	Ofwat core programme	Comments
SES Water to Southern Water (4Ml/d)	2025/26 to 2030/2031	2025/26 to 2030/2031	Requirement needed across both programmes. Costs attributed to recipient, Southern Water.
SES Water to Southern Water (10Ml/d) 'Outwood to Turners Hill'	From 2033/34	From 2033/34	Requirement needed across both programmes. Costs attributed to recipient, Southern Water.
SES Water to South East Water (10Ml/d) 'Bough Beech to Riverhill'	From 2038/39	From 2039/40	Requirement needed across both programmes, with a one-year delay in requirement. Costs attributed to recipient, South East Water.
SES Water to South East Water (5Ml/d) 'Outwood to Whitely Hill'	From 2048/49	-	Requirement only outlined in preferred plan. Costs would be attributed to recipient, South East Water.
Outwood Lane groundwater (2.7Ml/d)	From 2048/49	-	No requirement in Ofwat core programme. Sufficient lead in time to monitor requirement.
Secombe Centre UV (2.1Ml/d)	From 2054/55	-	No requirement in Ofwat core programme. Sufficient lead in time to monitor requirement.
Water Lane borehole enhancement (2.2Ml/d)	From 2061/62	-	No requirement in Ofwat core programme. Sufficient lead in time to monitor requirement.

18. We do not consider our customers are at risk of cost being incurred for options that may not be fully utilised due to the lead in times present before the two programmes differ. Before 2035 we will have:

- updated our environmental destination profiles based on a series of investigations between 2025-2030,
- monitored population and new development trends to understand growth in our area,
- remodelled our deployable outputs based on further climate change projections and likley assessed the appropriateness of current proposed profiles (making revisions where required), and
- prepared two further iterations of our WRMP based on the continued reassesment of our supply and demand forecasts, and evolution of adaptive and best value planning.

C. Robustness and sensitivity

19. In addition to points highlighted above, challenge has been provided across the following themes, which we consider requires review to ensure plan is robust.

Resilience

20. Our consultation requested further information on our drought resilience and the regional timing to meeting a 1 in 500 year resilience standard. We have presented our baseline supply demand balance and resilience in Chapter 5 and our preferred plan supply demand balance and resilience in Chapter 8.

21. For the baseline condition (in essence, without implementing any supply side or demand side measures), we forecast that we are resilient to 1 in 500-year system failure under DYAA demand conditions at the start of our plan in 2025/26.
22. Across the region, we each used simulation models to determine the deployable output of our systems under different drought events including the 1:500 year drought. This analysis was also used to determine the output from resource options. Using this information the regional group explored the impacts on the regional plan when moving all companies to the 1:500 year drought resilience standard at the same time.
23. Climate change was also accounted for, and the supply forecast used in the investment model therefore reflects a composite of current resilience standards, climate change impacts; and a step transition to the 1 in 500-year drought resilience standard. When developing the draft regional plan, WRSE tested achieving this level of resilience in 2035; 2040; 2045 and 2050.
24. Meeting the standard earlier requires more infrastructure to be developed regionally in order to meet the shortfall so there are increased pressures on customer bills in the short term. Delaying improving the resilience of the system increases the likelihood of customers and industry being impacted by severe droughts. The draft regional plan therefore set out achieving the standard by 2040, in line with government expectations.
25. Further sensitivity analysis since issuing the regional draft plan has concluded that meeting this standard of resilience by 2040 represents the best timing. The updated analysis shows that moving the design standard back to 2045 or 2050 does not delay the need for key strategic (regional) schemes to be constructed but impacts their full utilisation as a number of these schemes are required to deliver environmental protection.

Drought vulnerability assessment for our preferred plan

26. As indicated in Chapter 5, we have used our conjunctive use *Pywr* model to assess our drought vulnerability rather than UKWIR's Drought Vulnerability Framework. Our baseline supply demand balance was presented in Table 35. By adopting the options identified in our preferred plan, we can achieve an increased system resilience as indicated in Table 52.

Error! Reference source not found.Table 52: Preferred plan supply demand balance and drought vulnerability

Demand condition	System failure return period	Supply demand balance (Ml/d) (green/positive values represent a surplus; amber/negative values represent a deficit)			
		2025/26	2035/36	2040/41	2074/75
DYAA	1 in 2-year	45.16	65.56	55.66	49.00
	1 in 5-year	44.50	64.96	55.10	48.66
	1 in 10-year	43.33	63.86	54.03	47.82
	1 in 20-year	40.77	61.37	51.57	45.58
	1 in 50-year	34.90	55.57	45.80	40.04
	1 in 100-year	30.24	50.97	41.24	35.70
	1 in 200-year	24.90	45.83	36.21	31.38
	1 in 500-year	18.29	39.51	28.00	22.76
DYCP	1 in 2-year	49.13	82.05	84.36	93.59
	1 in 5-year	48.72	81.77	84.15	93.84

	1 in 10-year	47.60	80.79	83.24	93.38
	1 in 20-year	34.49	67.81	70.32	80.93
	1 in 50-year	17.77	51.23	53.81	64.87
	1 in 100-year	9.16	42.75	45.40	56.92
	1 in 200-year	3.87	37.80	40.62	53.29
	1 in 500-year	-2.41	31.96	33.38	46.48

27. It can be seen that for the preferred plan condition, we forecast that we are resilient to 1 in 500-year system failure under all except the DYCP demand condition at the start of the planning period in 2025/26. We have a slightly reduced resilience of between 1 in 200-year and 1 in 500-year at that time, but by 2035/36 we have achieved and maintain greater than 1 in 500-year resilience throughout the planning period to 2075 under both DYAA and DYCP demand conditions.

Demand forecast

28. We are notably working to recover our per capita consumption performance which was largely impacted by Covid-19, causing an upward rather than downward trend in this household consumption metric. Our Board and stakeholders, particularly our Environmental Scrutiny Panel, continue to monitor our operational work and wider factors affecting household consumption, so that we can best navigate the challenges arising to manage demand.

29. Our consultation and subsequent engagement sought further information on our starting position for this plan, and whether there is a vulnerability in the event we would not reach our 2025 performance levels despite ongoing activity. Since publishing our draft plan, we have also rebased our demand forecast to 2020/21, which is notably a year impacted by Covid-19, and have used a population forecast update (along with all regional companies).

30. The plan tables therefore reflect a baseline demand, baseline PCC and final planning PCC that accounts for Covid-19 changes in behaviour; and is therefore not wholly aligned with the current plan (WRMP19). Importantly, the supply demand balance is maintained throughout the proposed final plan. We undertook further (sensitivity) modelling to interpret whether our current metering implementation and conversion of those customers to measured rates, would materially affect the plan.

31. This sensitivity outlined a continued fulfilment of the same four transfers in our preferred plan, and outlined the latter two (to South East Water) would be delayed by a year in both instances. Similarly to the preferred plan, it is indicated that from 2040 we may need to rely on drought interventions in a dry year to fulfil those proposed exports (but not our own demand). We consider this forms part of the same discussion with South East Water (and others) as outlined above, so that we can refine the optioneering in future plans as companies develop alternative source options.

Demand management

32. Whilst we are recovering our demand management activities and we have proposed ambitious but deliverable activities for this plan going forward, to reduce consumption in line with the Government's expectation, we are unable to guarantee our strategies will be fully effective (even in the event we do achieve full implementation). There is a wider challenge relating to water use that is beyond our immediate control, although we do consider we have a role to play with the industry and wider stakeholders to encourage behaviour change and educate customers about water availability and consumption.

33. To understand how reduced efficacy of our demand management strategies may affect our plan, we undertook sensitivity analysis assuming a low level of demand intervention and reduced support from Government-led interventions. Based on this reduced level of intervention, our model indicates we would anticipate a deficit from 2045/46, which

coincides with the next step in our profiled abstraction reduction to meet our environmental destination.

34. We consider that this informs our proposed **monitoring**, and therefore business decision making, around:

- the effectiveness of demand management, future demand assessments, and possible requirements for further interventions,
- our assessment of risk to continue supporting proposed transfers, in context of other company plans to develop alternative supply options, to feed into future programme appraisals, and
- the assessment of our environmental destination, following the series of catchment investigations from 2025, to ensure we are planning for appropriate profiles of abstraction reduction to support the catchments we operate in.

35. This sensitivity analysis has also been considered in context of the costs associated with the plan. Testing on the draft plan indicated that slower profiles of demand reduction would reduce the cost burden of the plan whilst maintaining the supply demand balance and achieving a 110l/h/d PCC target by 2050. However, we have set out revised proposals for more ambitious demand management strategies (Chapter 6C) to meet the expectations of the Environmental Improvement Plan interim targets, therefore increasing the cost of the plan from 2025. This update reflects a PCC glidepath that should meet the interim targets in a normal year, but not in the dry year planning scenario.

36. We are now working to refine our proposed PCC profile as part of our long-term delivery strategy and business planning process.

D. Monitoring

37. The outline monitoring plan from Chapter 7 sets out components that remain reflective of the areas identified in the discussion above. We have aligned that plan with additional feedback from Defra and the Environment Agency, as well as specific components of our preferred plan. This is set out below, up to the second proposed transfer from 2033.

Plan component	Rationale	Monitoring	Stakeholders
Demand management activities	Review efficacy of proposed activities to inform business operations and strategic planning; and manage associated risks of effectiveness.	Annual Review data providing updates against targeted levels of our demand management activity. Consider external factors, such as government interventions.	Our business leadership and regulators in the event planned activity is not seeking the anticipated outcome. Regional companies demand reforecasts are provided to further planning iterations.
Our environmental destination (profile of abstraction reductions)	Outcomes of our WINEP investigations will be known by 2030 and we will have reviewed our environmental destination profiles as required.	Assess the appropriate adaptive plan branch, whilst implementing the revised profiles into future forecasts and iterations of the plan modelling.	Regional companies where adaptive branch is triggered and revised environmental destination profiles alter our supply forecast.
Headroom	Headroom is a composite measure used across companies as part of planning process.	Actual headroom being less than target headroom indicates review/action required to improve resource situation.	Regional companies in the event resource position conflicts with regional plan needs (see specific reference to transfer below). Business leadership to consider impact and corrective action needs.
Proposed transfer to Southern Water from 2033.	Assess viability of proposed transfer with sufficient lead in time. Also expected to be considered in WRMP29, WRMP34.	Population growth (unit) recorded in regulated annual reporting.	Southern Water, and regional companies where further plan iterations refine best value plan programmes.

38. From 2035 our preferred plan could diverge based on the adaptive branches. We therefore expect to continue developing our monitoring based on the ongoing conclusions and decision making.

E. Affordability and bill impacts

39. We commented in Chapter 7 that the best value (across the region and informing our plan), presented a lower cost than the least cost programme. This is owing to various options being optimised in our regional best value planning appraisal that provides neighbouring companies with alternative means to manage their supply and demand balance. This reduces the expected requirement for us to support bulk exports and therefore develop supply options.

40. Separately, our plan now features ambitious demand management strategies in the initial stages of the planning horizon so that we can align with the Government's expectations of the Environmental Improvement Plan. These strategies remain in all the programmes we have considered (such as the least cost, best value programmes) and a significant proportion of the cost of our plan therefore remains consistent in the first ten years of our plan.

41. We have aligned our estimate of the bill impacts of our plan with PR24 methodology[35] where possible, to provide a line of sight between the two plans. Our business plan will include further activities (that sit outside of the options set out in this plan to maintain our water resources supply demand balance) but that are equally important for the continued effective operation of our business.

Table 53 Estimated bill impacts from 2025 across key adaptive pathways and programmes

Programme or adaptive pathway	AMP8 bill impact	AMP9 bill impact	AMP 12 (2050) bill impact
Preferred (reported) pathway	£22.54	£42.41	£55.85
Ofwat core programme	£22.54	£42.41	£55.78
Alternative Plan 1 (Situation 1)	£22.54	£42.41	£58.68
Least cost programme	£22.54	£42.41	£63.00

42. The AMP8 profile more specifically starts at £16.46 across each programme, rising to £22.54 by the end of AMP8. The noticeable increase into AMP9 is owing to costs associated with asset renewal as part of leakage strategy.

43. Asset renewal will be an inevitable requirement to keep reducing leakage as we operate beyond the economic level of leakage. However, we have been able to delay this part of our leakage strategy, from AMP8 into AMP9, as we exhaust alternative solutions in the meantime. For example, we discussed our smart metering approach in Chapter 6 which will allow us to identify customer side leaks much faster than we currently can and support our customers to resolve issues on their supply pipes.

44. Development of our business plan is ongoing and we have undertaken further work to assess the full bill impact of our business-wide plans and test its affordability and acceptability with our customers. This also includes continued support to our customers that may be financially vulnerable. We will provide further details of this testing and our financial modelling outcomes as part of our LTDS and business plan submissions to Ofwat (due October 2023).

F. Environmental review

45. We have carried out a Strategic Environmental Assessment on our proposed plan up to 2050 to cover the statutory period. The assessment and supporting materials are provided in Appendix F. The summary assessment findings are provided below.

APPENDIX F
Strategic Environmental Assessment

Rationale to complete Strategic Environmental Assessment

46. Due to the potential for the plan to lead to schemes which will require an Environmental Impact Assessment, it is a statutory requirement that a SEA is undertaken under the

35 Bill impacts provided as 'real' (uninflated) assessment using totex information from Data Table 8. Costs were based on CPI(H) 2021 base year.

European Directive 2001/42/EC 'on the assessment of certain plans and programmes on the environment' (the 'SEA Directive'). The SEA Directive came into force in the UK through the Environmental Assessment of Plans and Programmes Regulations 2004 (the "SEA Regulations"). While the United Kingdom has now left the EU, the SEA Regulations still apply to a wide range of plans and programmes, including water resource management plans, and modifications to them, and have the following overarching objective:

47. "To provide for a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation and adoption of plans… with a view to promoting sustainable development, by ensuring that, in accordance with this Directive, an environmental assessment is carried out of certain plans… which are likely to have significant effects on the environment." (Article 1)

48. The main requirements introduced by the SEA Regulations are that:

- the findings of the SEA are published in an Environmental Report (ER), which sets out the significant effects of the draft plan;
- consultation is undertaken on the plan and the ER;
- the results of consultation are taken into account in decision-making relating to the adoption of the plan; and
- information on how the results of the SEA have been taken into account is made available to the public.

49. It is to be noted that SEA has been applied for the past three rolling 5-year cycles of WRMP preparation. SEA acts iteratively with Plan development to ensure that environmental and some economic and social considerations are made at the earliest stages. This is important as while the WRMP includes interventions developed both within the local supply area, and those shared with neighbouring water companies in order to increase supply, improve network resilience and connectivity and reduce pressures on water stressed sources for example, there is a potential that some of these solutions may cause adverse effects on the environment or the people of the area, particularly during their construction but also through operation.

50. For the current cycle of water resource planning (WRMP24), in addition to company planning, water resources are being planned at a regional scale, across water company boundaries. Via a collaborative approach, we are working with five other companies under the banner of Water Resources South East (WRSE) to deliver the National Framework for water resources and help safeguard continued supplies of water to this part of the country.

51. The WRSE regional resilience plan has also been the subject of SEA which has been undertaken at a level of detail commensurate with a regional scale assessment but not necessarily sufficient for a local water company plan. Thus we have undertaken SEA of WRMP24, considering environmental issues and opportunities informed by the work undertaken at the regional level by WRSE, in addition to identifying local issues particular to the supply area and which may not have been apparent at the regional level assessment.

52. The issues considered in the SEA are those set out under the SEA Regulations, namely of biodiversity, soils, the water environment, air and climate, cultural heritage, and landscape, as well as people-based topics of health and material assets. A bespoke assessment framework, compatible with that developed for WRSE as part of the regional SEA but specific to the SES Water area, was developed through a review of relevant plans and policies, as well as local baseline information. This ensured that relevant local issues would be addressed as part of the assessment process and would allow for mitigation to be

53. developed to help reduce any adverse effects identified, or to allow for opportunities for environmental improvement to form part of the WRMP development.

Informing the SEA

54. Alongside the SEA process and helping to inform it, a series of other environmental assessments have been undertaken by WRSE of particular water and biodiversity aspects that are relevant to water resource management planning and include Habitats Regulation Assessment, Natural Capital Assessment, Water Framework Directive Assessment, Biodiversity Net Gain Assessment and Invasive Non-Native Species Assessment.

APPENDIX F/G
Strategic Environmental Assessment components and Habitat Regulations Assessment

55. Within, and adjacent to our supply area there are areas which are considered some of the best habitats for wildlife in the country and have been designated to protect these areas as much as possible. Therefore, in addition to SEA, another specialist assessment has been made of the WRMP24. This assessment, known as a Habitats Regulations Assessment (HRA) is required by Regulation 105 of the Conservation (Natural Habitats, and species) Regulations 2017 (as amended by The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019), where a land use plan is likely to have a significant effect on such sites designated for nature conservation and is not directly connected with or necessary to the management of that site.

56. Such sites include Special Areas of Conservation (SAC) and Special Protection Areas (SPA). HRA is also required, as a matter of UK Government policy, for potential SPAs (pSPA), possible SACs (pSAC) and listed and proposed wetlands of international importance (Ramsar sites and proposed Ramsar sites) and sites identified, or required, as compensatory measures for adverse effects on habitats sites, pSPA, pSAC and listed or proposed Ramsar sites, for the purposes of considering plans and projects which may affect them. In short, an HRA determines whether there will be any ‘likely significant effects’ on any of these designated sites because of the implementation of the WRMP (either on its own or ‘in combination’ with other plans or projects) and, if so, whether these effects will result in any adverse effects on the site’s integrity.

57. The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 require all natural water bodies to achieve both Good Chemical Status (GCS) and Good Ecological Status (GES) which, collectively, result in a water body classification of good status. Similarly, River Basin Management Plans (RBMP) outline the actions required to enable natural water bodies to achieve good status. New activities and schemes that affect the water environment and which may be derived from the WRMP may adversely impact biological, hydromorphological, physico-chemical and/or chemical quality elements (WFD quality elements), leading to a deterioration in the baseline water body status. As such, careful consideration of Options within the WRMP has been made to determine effects on waterbodies.

58. Biodiversity Net Gain (BNG) is an approach that aims to leave the natural environment in a measurably better state than beforehand. Natural England have produced a Biodiversity Metric that provides a way of measuring and accounting for biodiversity losses and gains resulting from development or land management change.

59. Natural capital is defined in the 25 Year Environment Plan (England) as “the elements of nature that either directly or indirectly provide value to people”. As a new and emerging approach, natural capital incorporates methodologies and approaches (such as ecosystem services) to understand the value that natural assets provide. For the water industry, these can be substantial. The Water Resource Planning Guidelines (WRPG) (England and Wales) states that Water Resource Management Plans (WRMPs) should “use natural capital in decision-making”, “use a proportionate natural capital approach”, “deliver environmental net gain”, and provide cost information on monetised ecosystem service costs and benefits where monetisation is used.

60. An Invasive Non-Native Species (INNS) assessment has also been carried out to determine the threat of spreading INNS throughout the water supply network and specific resource options and assess ways of mitigating this spread. The results of these INNS

investigations have formed part of the SEA process for the biodiversity and water objectives. INNS dispersal can occur through a range of recreational and operational (water company) ‘pathways’, which may include water or land-based recreation and sports, and water company operations, such as ground maintenance and the operation of raw water transfers (RWTs).

Undertaking the SEA

61. This SEA has built upon work undertaken by WRSE of initial Option Screening. This helped to ensure fairness as options both inside and across the region are assessed consistently, objectively and transparently and it was the objective of the initial screening to remove Options that have an unacceptable environmental effect, a high risk of failure or an insufficient yield or demand reduction. The feasible options were then developed to determine costs and assess environmental and social impacts, so that they could be modelled to produce the required solution to the planning problem.

62. During the process of developing options, a range of considerations were made relating, for example to Government Policy, customer preferences and resilience. 41 options or option groups, relating to hard infrastructure, demand management and drought measures were considered feasible and we calculated costs, including capex, opex, social, environmental and carbon for each option. Options relating to catchment management were not found to increase deployable output but are recommended for consideration as part of a wider approach to reducing the need for end-of-pipe solutions such as additional treatment as well as enhancing biodiversity.

63. The results of the assessment were uploaded to the WRSE database to be used in the regional programme appraisal. Those options which were considered better performing in respect of the issues noted above were then proposed for inclusion to WRMP24 and were subject to further consideration, with a particular focus on ‘local’ issues. The options proposed in our plan which were subject to SEA are:

- Outwood Lane
- Raising of Bough Beech reservoir
- Hackbridge drought permit
- Kenley and Purley drought permit
- SES Demand: Gov-led C++ Hybrid
- Demand Basket High+ SES
- Non-Essential Use Ban (NEUB)
- Temporary Use Ban (TUB)

64. These options were then considered through our SEA processes alongside and iteratively with the development of the WRMP24. While this built upon the early work undertaken by WRSE, this SEA process utilised a Framework that had been developed via a review of local baseline, as well as a review of plans and programmes of relevance to our supply area. As such, the Objectives developed for consideration of WRMP24 and the associated decision aid questions, while reflective of those used by WRSE, ensured consideration of issues of particular relevance to our supply area. It also utilised a bespoke Geographical Information System which allowed identification of environmental and social constraints through a series of maps and associated information layers relevant to the area to help provide quantitative consideration of where options are located spatially within the Plan area.

65. The SEA rationale for our plan adopted and built upon WRSE’s approach to include for example, consideration of RSPB Reserves, SSSI Impact Risk Zones, National Priority

Focus Areas, Nature Improvement Areas, Chalk Rivers under the Biodiversity topic, consideration of Geological SSSIs and Open Mosaic Habitat (previously developed land) under Soils topic, Roman Roads under Heritage and locations of National Grid Infrastructure (gas and electricity) under Material Asset topics. These additional considerations were then used to inform a more comprehensive and localised understanding of Option effects during both construction and operation (where applicable).

66. Options were a mix of Demand Management and Supply Options and all were considered in respect of anticipated effects (positive or negative), across both the construction and operational phases. Consideration of the identified anticipated effects also allowed a scale of effect to be applied to each option in light of each of the SEA Objectives – those effects deemed to be moderate or major were considered to be significant. Each option was then considered in light of other Options with which it could interact to generate cumulative effects.

67. WRSE were then informed of the results of the assessments to allow further consideration of more 'local' issues within the Regional Plan. The results also helped to provide relevant information to be considered alongside other technical issues to help identify the Best Value Plan.

Findings of the SEA

68. The SEA and other assessments carried out throughout the development of WRMP24 has been thorough and comprehensive. Assessment was made of an initial long list of sites and environmental issues were considered through all stages of short listing and Option development. This was at both a regional level (carried out by WRSE) and at a more 'local' level that considered issues in light of the environmental context of the SES Water area. Consideration of both the regional and local level has meant that two SEA teams have been involved and have acted independently of each other, though liaison has been maintained and results of assessments shared. These teams have also liaised closely with the SES Water WRMP24 making team and have challenged the Plan development team when appropriate.

69. Based on the findings of the SEA, it is possible to recognise a number of key considerations and draw conclusions with regards to the WRMP24 and its 'environmental performance':

- The nature of the proposed options means that only six (Outwood Lane, Water Lane, Secombe Centre UV, Duckpit Wood, Raising Bough Beech Reservoir and leakage reduction actvities) are anticipated to have construction effects.
- While identified construction effects are adverse (with no beneficial effects identified at this stage), none are considered to be significant.
- Slight adverse effects have been identified during construction in relation to climate change, biodiversity, air, noise and climate emissions, landscape, historic assets, health and wellbeing, resource use and effects on assets. These would be expected of any construction activities and can be mitigated by existing and readily understood techniques.
- Adverse effects have also been identified during the Operational phase. Such effects have been identified across a greater range of Options, including those relating to Demand Management. For the most part these are considered slight and non-significant.
- Significant adverse effects during operation have only been identified for the supply side options, relating to the water environment as a result of potential effects on groundwater through the Chalk layer or due to proximity to a water body and it not being possible to rule out effects on water quality or quantity.

- Benefitical effects have been identified in relation to improved resilience to droughts that will be exacerbated by climate change, the protection of water resources, biodiversity and improved health and wellbeing.
- Overall, the SEA concludes that our plan has been subject to thorough and comprehensive environmental assessments, at a regional and local level. We have given robust consideration of alternatives and appraised programmes to identify a preferred set of options.

Carbon Emissions

70. We have assessed the carbon emissions for each option based on a regionally consistent approach which includes embodied carbon (e.g. from construction and asset materials) and operational carbon from electricity and chemicals.

71. Total carbon or greenhouse gas (GhG) emissions for the plan in terms of water production are shown in Table 53. The embodied emissions are heavily reduced from the draft plan owing to the raising of Bough Beech not forming art of our preferred pathway. Based on the carbon consistency methodology developed by Mott McDonald for WRSE, the total carbon cost of our plan is less than £1M.

Table 54 Carbon emissions associated with our plan

Type	Emissions (tCO^2)
Embodied emissions	1,084
Operational emissions	293,483

72. This excludes the benefit of demand-side options which would lead to a reduction in water abstraction, treatment and network pumping, which would result in a net benefit in carbon dioxide emissions. Although the company only uses energy generated from renewable sources, there would be a reduction in hot water usage by customers which would reduce overall greenhouse gas emissions linked to water usage. Other measures would also contribute to lower emissions, including the continued roll-out of electric vehicles across our fleet.

Climate change adaptation

73. We carried out a review of our Climate Change Adaptation report in November 2021 as part of a submission to Defra. We assessed the risks of the latest climate forecasts to a range of factors, most of which are related to water resources planning including drought, peak demand, water quality, natural capital, flooding and supply interruptions. Many of the mitigation actions in place are within this plan, including reducing demand, drought resilience, catchment management and leakage control during weather extremes.

74. We committed in the report to enhancing progress with the steps needed against risks which have not been sufficiently mitigated and to carry out more research where there are gaps in our knowledge. Discussion with our Environmental Scrutiny Panel highlighted opportunities to align our climate change adaptation with Defra's Integrated Plan for Water, such as considering our climate adaptation risks across geographic areas and catchments. We believe the outputs of our environmental destination investigations, to support our commitment in this plan to reduce abstractions, should feed into our next iteration of our climate change adaptation report. This should enable us to assess and manage risks associated with climate change without inadvertently impacting our delivery of wider environmental ambition.

G. Interpreting our plan into our Long-Term Delivery Strategy (LTDS)

75. This plan forms one of the key inputs into the Long-Term Delivery Strategy and investment plans for our PR24 business plan. It sets the basis for demand reductions, environmental improvements in catchments and where additional supply-side schemes are needed to enhance our deployable output in the long-term. Both plans have an adaptive planning basis to manage uncertainties regarding the future outside of the company's control.

76. Our ambition has not been limited to the scope of this plan and we are proposing activities to ensure effective, resilient and efficient business operation for our customers, whilst challenging ourselves to deliver more with less.

We have carried out further modelling to support the alignment of our plan to Ofwat's expectations of the LTDS. We will continue to provide further information beyond submission of our LTDS and business plan where required to support this process.

> We have set out our analysis of the plan's sensitivity across resilience, drought vulnerability and demand components, commenting on the monitoring throughout that is required to inform our continued decision making and further iterations of the plan. We outline that there are no differences in the initial planning period between our preferred plan and the Ofwat core programme, but comment on monitoring we will undertake to ensure our customers are not at risk of paying for investments that may not be fully utilised.
>
> We have assessed the bill impact of our plan, at approximately £22.54 in AMP8. We have set out that our current business planning is considering the associated costs together with further business requirements proposals to assess the affordability and acceptability with our customers.
>
> Our Strategic Environmental Assessment concludes that the proposed plan is well-balanced in terms of environmental benefits. We believe that, following updates since publishing our draft, the plan is optimal across our customer and stakeholder priorities.

SECTION 9

Section 9 Quality Assurance

9. Quality Assurance

This plan has required a detailed and complex series of steps to develop the forecasts, undertake investment modelling and appraise the best value plan. Clearly this required a governance structure and assurance programme that matched this level of technical and consultative analysis that was at a regional scale. We detail the assurance stages that have taken place at a regional and company level, and the steps taken to approve the plan at a Board level.

A. Governance structure

1. Details of the governance structure of the WRSE is given in Technical Annex 1 of the WRSE Draft Regional Plan. SES is represented at each level; our CEO attends the Strategic Leadership Team, our Wholesale Director on the Oversight Group, and the Water Strategy Manager on the Project Management Board and Environmental Advisory Group. The Engagement and Communications Board is attended by our Head of Communications.
2. This structure provides a framework for decision making and encourages wide collaboration between the companies and a wide set of stakeholders including regulators and non-public water supply users.

B. Assurance methodology

3. To ensure robust processes are followed, WRSE has published and consulted on a series of method statements from July 2020. This is to provide confidence and assurance to water companies, regulators, and stakeholders that as a region we are compliant with relevant guidelines and good practice, and that the data input process is uniform across the teams in each company. We contributed to the development and sign-off of these method statements.
4. Where we have developed the data inputs, including the micro-components analysis, supply and demand forecasts and options, this has been subject to the assurance process in place with our consultants at Atkins and Artesia. The data has also checked by the technical leads at SES. In addition, we have been subject to external auditing commissioned by WRSE, with these findings presented to the Senior Leadership Team for their review and sign off and reflected as appropriate in this dWRMP. A separate document on the WRSE assurance process will be published alongside the draft regional plan.

C. Board assurance of our plan

5. Ofwat, the economic regulator, and the Environment Agency, the environmental regulator for the water sector, require the Company's Board of Directors to make a statement regarding assurance of the information in this WRMP document. This assurance statement is copied below.

Statement of Assurance of the WRMP 2024

We confirm that the Company's WRMP 2024 has been reviewed and approved under the governance arrangements approved by the Board.

The Board certifies that:

- The Company considers that it has complied with its obligations relating to the Water Industry Act 1991 as set out in sections 37A to 37D, and HM Government's water resource planning guidelines, updated July 2022.
- The Company has appropriate systems and processes in place to make sure that the information contained in the WRMP is accurate.
- The Company has ensured that this WRMP accurately reflects the Regional Resilience Plan 2024 (RRP24) developed by WRSE and has been developed in accordance with the national framework and relevant guidance and policy.
- The Company has ensured that the WRMP is the best value plan for managing and developing the required water resources to continue to meet the Company's obligations and where appropriate, provide support regionally as required by the regional resilience plan.

In making this statement of assurance the Board has relied on:

- The Company's well-established risk management, monitoring and control systems and processes described in the Company's Strategic Report which can be found from pages 63 of the Company's 2022 Annual Report, available on the Company's website.
- Periodic and recurring engagement between the Company and senior representation from WRSE over the course of the last three years to understand and agree principles and processes and to receive progress updates on the creation of the RRP24.
- The evidence presented by the Company to demonstrate the influence and interdependency of the RRP24 on the WRMP.
- The evidence presented by the Company – in the form of numerous 'deep-dives' dedicated to the engagement, oversight and scrutiny into the water resource planning process – of our interventions across broad components of the planning process including water resource management, drought planning and leakage and PCC reduction.
- The assurance processes undertaken by the Company and its third party advisors and the equivalent undertaken by WRSE.

Signed on behalf of the Board of Directors on 31 August 2023[36].

Ian Cain
(Group Chief Executive Officer)

Rebecca Wiles
(Independent Non-Executive Director)

Paul Kerr
(Group Chief Financial Officer)

36 Board assurance remains from 31 August 2023 on account of no material changes to the final plan from the revised draft. Edits made to this document have been to provide clarity or undertake presentational updates in response to Defra.